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THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

Health Instruction in the Curriculum—*Oberteuffer*
Effects of Procain-Epinephrin on Pulp—*Hellner*
Traumatic Occlusion—*McCall*
Roentgen Ray in Orthodontia—*Casto*
Posteruptive Changes in Enamel—*Beust*
Fixed Bridgework—*Doxtater*
Esthetics of Denture Construction—*Willis*
Gingivae of Rat Molar—*Skillen*
Orthodontist and General Practitioner—*Griffin*
Adamantinoma—*Kronfeld*
Removal of Impacted Teeth—*Puterbaugh*
Studies in Rickets—*Greenebaum and Others*

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Calcium Fixation—*Howe*
Dietary Control of Caries—*Drain and Boyd*

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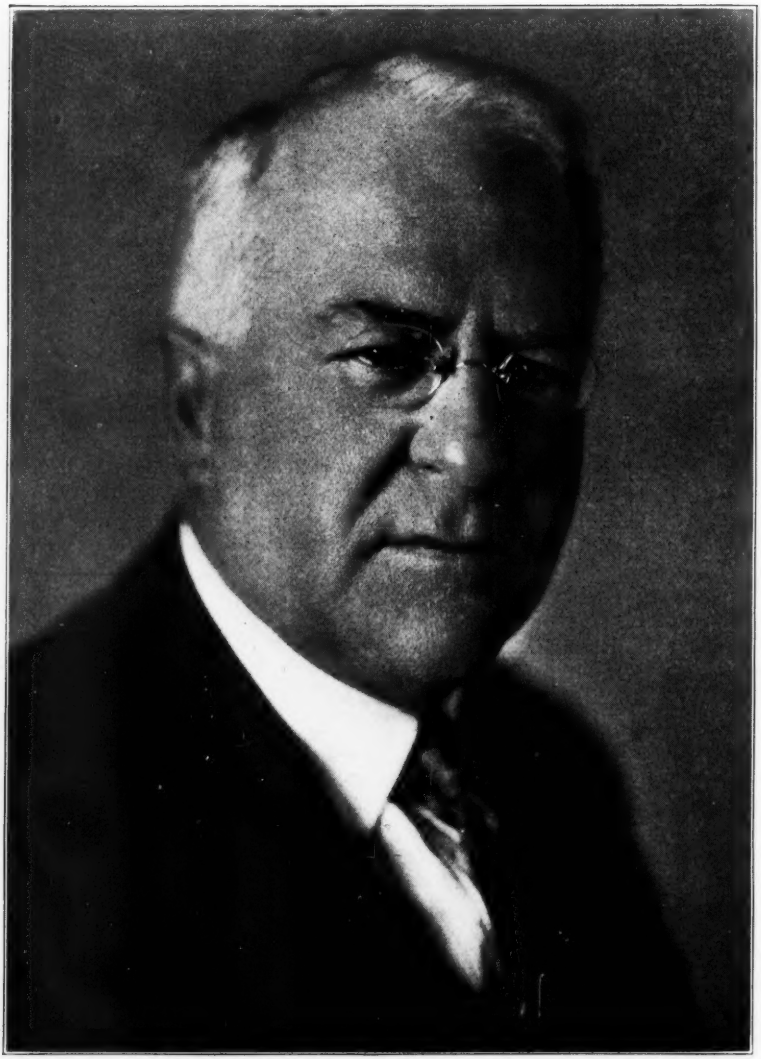

SENATOR JAMES COUZENS

UNIV. OF MICH.

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Original Communications

SOME OF THE FACTORS INVOLVED IN INCORPORATING HEALTH INSTRUCTION IN THE CURRICULUM*

By D. OBERTEUFFER, Ph.D.,† Columbus, Ohio

EDUCATION in health has been only partly incorporated in the modern school curriculum. There are many conditions obstructing the adoption of a complete program of health instruction for all school children. It is the purpose of this paper to discuss four of these.

1. Health instruction does not, at the present time, receive the same recognition as a unit of the curriculum as the older academic subjects. There is no state in this country at present which lists it as a requirement for graduation from high school. Several states recognize a credit in physical education, which may involve health instruction somewhere along the line. Some individual school systems may also recognize the subject. Up to now, school people, generally, have clung rather definitely to the central idea that only the older, more traditional subjects, such as the "three R's," really count as units of education. Other studies, such as music, art and physical education, have been termed "special subjects," and as such are set apart from the regular company of the so-called "solid" subjects.

All this has its background, of course, in the early conceptions of a school and its purposes. Culture was, historically, largely Latin and Greek, with the useful reading and writing thrown in. School was a place where the brain cells were charged with knowledge to be used at convenient times later on. Mind was glorified; the body was crass, not to be spoken of except by physicians. Health was something to be regained when lost. It served as a convenient excuse for a fortnight at the seashore, or in the moun-

*Read before the Section on Mouth Hygiene at the Midwinter Meeting of the Chicago Dental Society, Jan. 15, 1930.

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tains in the summer. Vacations were taken to allow health to come back and color to be restored to the academic cheeks. To study how to live so as to make vacations for such purposes unnecessary had not appeared on the horizon of a slowly evolving curriculum.

The older subjects, such as history, geometry, algebra and geography, have all had the best of it. No school was complete without them. To miss the pleasures of knowing that two triangles are congruent if they have two respective sides and included angles equal was to mark a 13-year-old future housewife or billing clerk as decidedly uneducated. Ask many people today what subjects American schools should teach. You will find them replying, through the mists of memory, as they recall their own struggles with $x + y$ or the tributaries of the Euphrates, that the schools should stick to "the fundamentals of learning."

But, as has been suggested, the curriculum of the modern school has evolved. School people now talk about child interest, projects, contracts, platoons and other indices of change. The principles underlying education are changing. The theme, now, is to better equip boys and girls for the kinds of lives they will lead, to offer them guidance and to help them live fully each day. The idea of schooling developing anything else than specific abilities or qualities has been largely forsaken. Algebra no longer makes an analytic mind, and the persistence required to memorize "Hiawatha" is not thought to contribute much to the ability to succeed as a bond salesman. Changes have appeared which have enriched our schools. Probably no adult today could fail to improve his elementary and secondary education if he were to go back and try again.

But the change is not over yet. Health instruction, among other new features, is trying to edge its way in. Those interested in the movement, including health educators, physicians, dentists and public health workers, have tried to convince educators that probably the greatest favor schools can do the child is to teach him to live more wholesomely, to be stronger in a physical sense and to so order his life that he lives at his best. These proponents have been eminently successful in a few places, but only moderately so in most others. Changes in the fundamentals of our educational system are slow and difficult to make.

Just how can health instruction justify a place in schools? It is true that the usual daily program of a school boy or girl is crowded. The addition of numerous activities, such as clubs, plays and athletics, to their schedule has made American school life, for some youngsters at least, strenuous indeed. It is complained that many children break down under the strain, and the addition of any new course or project is unthinkable.

A study of personal hygiene should increase personal efficiency. The practice of hygienic activities, such as training oneself not to worry, to recreate, to eat wisely or to take adequate rest, nearly always results in a fuller, more efficient life, and a greater duration of the best years of one's life. Health, properly taught, ought to teach school children how to evaluate the elements of life, how to accomplish their purposes with the greatest aid from their physical being, and should equip them with the practices of modern sanitation to the extent that disease incidence is less. Here is a matter of relative values. What good is it that one learns how to make out a bank draft if one goes into a nervous breakdown having made one out wrong? What good is it to know the details of the founding of a political party and not to know how

to keep one's temper in a political argument? Would not a sense of values indicate that to learn to eat a salad a day was of greater good than to know that Magellan first sailed the Horn?

Health instruction is essentially a study of the processes of life. As such, it has a concrete, practical, bread-and-butter contribution to make to human welfare. The only reason it has not made its bid for a place in the schools until recently was because the body of fact behind it was inadequate. Modern biologic science is not very old. Hygiene, because it applies to life what is known in science, must wait on the source material. There was little geography taught until the world was better known, and not much history until facts of the past were uncovered. So it is with health. The last two decades have seen great strides in the field. Boys and girls can be taught something now. A modern course of study in health education need have few folk-tales nor be attended by ancient prejudices.

But the curriculum is crowded. One principal said, "If you add a course in health to the already overcrowded programs of my boys and girls, you will actually *injure* their health." That point of view is precisely the same as denying a drowning man a lifesaver because he is too busy thrashing his arms about in the water to handle anything else. If the modern curriculum is too crowded, something needs to be cut out or condensed in order to make room for health instruction.

What are the facts? In elementary schools, many grades are taught health for possibly ten minutes, three times a week. Some schools, in the more enlightened places, give it a full period of from twenty to forty-five minutes a day. There is no standard practice.

Ayres[1] indicated in 1924 that the study of hygiene received less time in minutes spent on it per week than any other elementary school subject except civics. He further showed[2] that cities average about twenty minutes of hygiene instruction a week in each elementary grade as compared to 200 for arithmetic, seventy-five for history, and 100 for geography.

No state at present requires credit in secondary schools for health instruction. Some will accept it in addition to other basic requirements. That means that it must be a second-rate, "special" subject. Geography is more important; *it* is recognized. History is more vital; credit is given for *it*. Some high schools require it for graduation, *in addition to* the regular sixteen units required by colleges. The requirements for college entrance, usually sixteen units of secondary school work, are, in some places, flexible, and it is hoped that they will yield to health education, thereby placing the subject in its true proportions as a factor in the education of the individual.

State laws usually specify the minimum number of units for graduation to be earned from English, the social studies, the natural sciences and mathematics. Additional credit may be earned to make up the traditional sixteen. This is usually done by taking more of the same subjects. It is unsafe at present to take health and physical education, hoping to have it count as a unit for college entrance. The majority of colleges recognize only the "solid" subjects. What is needed here is obvious. Instruction in health and physical education must be improved and programs be built up so they will be worthy of recognition as

1. Ayres, F. C.: Studies in Administrative Research, 1924, Seattle Public Schools Bulletin No. 1, p. 12.

2. Footnote 1, p. 9.

"solid" subjects. (It should be understood here that physical education is mentioned only because of its usual alliance with health instruction.) It is important that colleges accept credit in health education, that secondary schools give full time and credit to it, that other subjects be modified to make room for it and that elementary schools make it as vital a matter as reading and writing.

2. A second condition which is delaying the incorporation of health instruction into the curriculum is the indecision among educators as to a suitable vehicle to use in teaching the subject. Should special time be given to health instruction in the elementary schools? Should there be a course called hygiene, or health, in the secondary schools? Or should health be dovetailed in with other subjects, taught by correlation and integration with other departments? There is some unanimity of opinion on this, but not much. It is generally thought now that the regular classroom teacher in the elementary school should teach health through the other subjects as well as through specific instruction. The primary and intermediate grades are more successful in doing this than the upper grades. Above the sixth year, health instruction is quite generally hit or miss.

What vehicle should be used? How should the program be arranged so as to allow every boy and girl to have instruction in hygiene? There are those who rely entirely on teaching health through other subjects. Laton[3] has shown the opportunities for teaching health through biology. Meir[4] has revealed the health material available in science textbooks. Swalwell[5] has indicated the possibilities of working health information into such subjects as English, history and mathematics. Such efforts are highly commendable. The sanitary aspects of the Civil War may as well be told as the political line-up. The origin of quarantine laws may as well be included in the history of the Mediterranean merchants, and the epidemic of smallpox in Boston described along with other prerevolution details. General science has unlimited opportunity to make contributions to the health education of a pupil, and through biology or home economics a great deal of value may be learned.

The serious question is raised as to whether, in the upper six grades, we can justify the leaving of all health instruction to correlation with these other subjects. Should not a specific, definite course be given, either throughout these six years or for parts of them? A number of factors are immediately apparent. It is said that health must be learned from native sources, in its natural state; and that to center attention on health as a subject will tend to make boys and girls health conscious and therefore ill. Correlation is the reasonable solution, it is said, because it affords a more natural way to study life and also requires less alteration of the curriculum and other mechanical features of the school.

On the other hand, it is significant to conjure the possibilities of this idea of correlation if carried too far. Is there not a course in reading and later one in literature? And yet much of reading and writing is done in connection with other subjects and outside of school. It is thought that it is better to teach some-

3. Laton, Anita D.: Psychology of Learning Applied to Health Education Through Biology, New York: Teachers' College, Columbia University, 1929.

4. Meir, Lois: Health Material in Science Textbooks, New York: Teachers' College, Columbia University, 1927.

5. Swalwell, Belva: Teaching Health in High School, University of Iowa Bulletin 115, 1925.

thing of these subjects. One can learn history from studying Spanish literature, but it would be a tedious and perhaps an inadequate study. It would be interesting indeed if, in home economics, we depended on historical recitations of the culinary arts of the court of Queen Elizabeth for our knowledge of cookery.

It is insisted that we be more specific in our studies. To learn animal husbandry, one studies animals, not astronomy. To learn history, one studies historical works, not the T-square or the hypotenuse. What distressing complications invariably arise when one tries to teach the facts of human sex life by relying entirely on analogy to butterflies or puppies. The basic study is that of human health. It, then, should be made the center. Why not learn science from health, instead of health from science?

Furthermore, teachers of these other subjects find it difficult to teach the health aspects of their work. They are not prepared for it. Literature does not yield gracefully to sanitary essays. Cairns[6] points out that only physiology, biology and general science have a really fine opportunity for teaching health material. Correlation is desirable, but it should not be relied on to cover the entire field of health information. Health subject matter is available now in such quantities that a definite course is needed in all schools, except, perhaps, those exceptionally high-grade high schools with well-trained personnel.

In proposing a specific course in high schools, required of all students, the matter of relative values again enters. Which is more important in the life of a high school girl: that she take courses in algebra and geometry or that she take a course in health? Education[7] cites health as its first objective. Which comes closer to meeting this ideal, a knowledge of how to balance an equation or a knowledge of how to balance the family dinner?

To rely on correlation alone would be hazardous. There is too much material of importance to be covered in the field of health. Cairns[8] has revealed a wealth of subject material from mortality and morbidity tables. Strang[9] and Lerrigo[10] have uncovered enough material to overload a science course. I[11] have shown the health interests of freshmen college students to be of such kind and number as to be answerable only in a specific course. Early reports from research now under way[12] in the high school field indicate that there is so much to be taught that a definite course seems the only solution. Such a vehicle is recommended to carry the answers to the health problems of boys and girls.

3. Any program of health education in the schools requires a trained personnel for its execution. Health, more than any other subject, is one which cannot be taught by just anyone. The danger of repetition of fallacy and pseudo-

6. Cairns, Laura: Scientific Basis for Health Instruction in Public Schools, University of California Publications, Vol. 2, No. 5, p. 418, 1929.

7. The Cardinal Principles of Secondary Education. Report of the Commission on the Reorganization of Secondary Education, Appointed by the National Education Association. Bulletin, 1918, No. 35, p. 10. Department of Interior, Office of Education.

8. Footnote 6, Chapters 1 and 2.

9. Strang, Ruth: Subject Matter in Health Education, New York: Teachers' College, Columbia University, 1926.

10. Lerrigo, Marion O. Health Problem Sources, New York: Teachers' College, Columbia University, 1927.

11. Oberteuffer, D.: Personal Hygiene for College Students, New York: Teachers' College, Columbia University, 1930.

12. Health Education Course of Study Research Project, State Department of Education, Ohio, 1929.

science is too great. The teacher needs to know the basis of health as a science in order to understand nature's operations, and to have, if there is such a thing, the scientific point of view.

If health instruction in the first six grades is left to the classroom teacher, every teacher in a school system should have, as part of her professional training, work in health education. That means that every teacher-training institution in the country should give training in the teaching of health. They are not now so doing. Although figures are not available for any considerable share of schools and colleges, it may be estimated that less than 20 per cent of them offer courses in the subject, and even where courses are available, they are seldom compulsory. This means an annual crop of new elementary teachers who, unless they have had some science, are completely in ignorance as to how and what to teach in health.

If special teachers are needed in platoon schools and in high schools, they, also, should be thoroughly trained. Graduation from a four year college or university with a major specialty in health and physical education should be a universal requirement for such teachers coming new into the field.

Teachers already in service, i. e., those now teaching, ordinarily do not go back for an additional full year's work. They return to summer sessions and extension work for their additional training. If teacher training institutions will provide these teachers with an opportunity for a study of health education, the program can be that much improved. Not enough colleges are doing this. Several in each state offer training in physical education in summer; some go to great pains to offer elaborate courses for the training of a football or basketball team, but not many provide opportunities for the study of the teaching of health. In one state, which is well up the list in its health education program, only five of the ten professional college departments of health and physical education offer summer work in health education. Only one college of the same ten gives instruction through extension services. This means an annual influx of new teachers, some trained, some untrained, to take their places alongside older teachers who are largely untrained in this new field. The job is being poorly done.

What training is necessary? Distinction must be made between an elementary general teacher and a special teacher of health education. Galdston,[13] after a study in the New York Training School, reports that "the training of the teacher should begin in the high schools . . . in the basic sciences, i. e., physics, chemistry and biology. . . . An elementary course in health education should be obligatory for all teachers in training." This course should aim to "give the teacher a knowledge of how his own health and the health of the children under his care can be safeguarded in and out of school. And it should train the teachers in a knowledge and appreciation of the content and technique of health education." Ohio's State Department of Education recommends a forty-eight-hour course[14] combining the teaching of health with a study of school health problems. Even better, perhaps, would be the recommendation that as many teachers as possible choose health and physical education as a

13. Galdston, Iago: Health Education in Teacher Training Schools, New York, 1929, New York Tuberculosis and Health Association, p. 8.

14. The Teaching of Health and School Health Problems. Columbus, 1929, Division of Health and Physical Education, Department of Education, State of Ohio.

"minor." They could then take from twelve to twenty hours in the subject, this depending on the institution's requirement. Hayhurst's[15] suggestions for a model minor program for training health education teachers are given in the accompanying table.

PROGRAM FOR TRAINING HEALTH EDUCATION TEACHERS

Subject	Credit Hours
Human anatomy	4
Human physiology	4
Pathogenic bacteria	2
Immunity	1
Epidemic diseases and epidomiology	2
Community health and its administration	2
Child hygiene, with emphasis on habits and nutrition	5
Total	20

There is little question that some training is necessary. This training must, basically, be in three fields: biologic sciences, education and health education. No one is sufficient without the other two. The trained biologist will not *per se* make a good teacher of health. Neither will the physician; nor the educator. School physicians and dentists who teach should be trained in education. It is a mistake to develop the impression that school health teaching or any other form of public health education is a knack which automatically accompanies a professional education. Physicians and dentists who teach may, unless they are trained in education, make serious mistakes. The school health teacher needs three talents: biology, education and the special study of health education. It is a matter of biology, for instance, whether teeth ought to be cleaned; a matter of education whether the mass drill is the best way to teach brushing, and a matter of health education to know who needs dental care.

Opportunity for this training, in normal schools and colleges, is not keeping pace with the growth of the subject in schools. Several states are now distributing printed courses of study in health education to all schools, but those in charge report a serious lack of trained personnel to teach the courses. Untrained teachers will repeat folklore, and quackery will be fostered. Scientific health instruction lies in the balance.

4. The selection of suitable subject material remains to be discussed. There are generally two types of subject matter: that which the adult thinks the child should know and that which the child wants to know. Textbooks are generally written from the former point of view. As such, they are inadequate. Some attention must be paid to the interests, needs and curiosity of boys and girls at each step in their life. Simply to prepare them for adulthood is not sufficient. Bobbitt[16] expresses this as follows:

> Is it enough to aim at current living and not at the distant adult future? We can best answer by means of an illustration. In the health education of a child, the elementary school is aiming, let us say, at right current physical living all of the time by the child. Day by day, and month after month, it assists him rightly to manage his food activities, his sleep, the ventilation of his room, his personal cleanliness, his daily exercise, his watchfulness against infection, and other similar matters. All this is merely the guidance of his current physical living. There is little thought, at the time, of the way he is to manage these things twenty years hence, when he is an adult. The function of the school is to see that he is proficient all of the time in these current activities. The

15. Report of Special Committee of Ohio Society of Sanitarians on Teacher Training in Health Education. Columbus, 1929. Department of Health, State of Ohio.

16. Bobbitt, Franklin: The Objectives of Our Modern Education, Ohio Schools, Vol. 7, No. 10, p. 365, December, 1929.

process, then, continues after the elementary school through six or eight further years of high school and college. This means, in total, some fourteen years of current performance of health activities influenced, guided and supervised by the school. So to live for fourteen years will give enough practice to fix the guiding information, the habits, the physical tastes and the appreciations. It will project him forward upon a high level of performance through his adult years. He will be prepared actually and not merely in a verbal and pretended way. This aiming at current behavior through long years will train for the continuity of the same kind of behavior during adult years. It is probable that there is no other way of genuinely preparing for adulthood. It is probable that the other ways are only make-believe.

Where, then, can one find the current problems of child life? They can be revealed only by research. Cairns[17] has shown many in her study on source material. I have reported the detailed health interests of about 2,000 college freshmen.[18] The department of education in Ohio[19] is engaged now on a twelve-month search in junior and senior high schools to uncover the exact health needs and interests of high school children. The results of the latter project will form the basis of a course of study which will be centered, primarily, on current problems, rather than on remote interests of adult life.

These studies have indicated, among other things, that problems of health are not all physical. From the Ohio study, for example, come questions such as, "What does a person's outlook on life have to do with his health?" "Is worry natural?" "What causes a nervous breakdown?" Anyone choosing to make up a course in health and hygiene should give up the quaint notion that physical things only need discussion. The subject matter of hygiene is as broad as life itself.

Hygiene must, above all else, be presented scientifically. Accuracy and truth prevailing at all times will prevent misconception, bewilderment and economic waste. It is well known that there are many contestable points in hygiene; nevertheless, writers and authors of courses should select material of known and proven accuracy. To teach that the only factor in dental hygiene is the toothbrush is antiquated and inaccurate. Likewise are many other teachings; for example, breathing exercises as preventive against tuberculosis; the flat chest as a sign of pulmonary weakness; vegetable foods as a contributor to meekness of spirit; ramrod posture as essential to digestion; or magic formulae as useful in illness. Health has probably never been more popular than it is today. One sees it everywhere. There is danger of mixing values. One may not be able, because of the bombardment from the advertisers, to know consequential things from petty. One may become more concerned over a brand of tooth paste than over foci of infection; or one may be so enthusiastic over exercise as a health builder that he will buy a mechanical belt or a hobby horse, rather than seeing exercise as recreation or valuable as education in a worthy use of leisure. It is rumored that some are even campaigning for whole wheat bread at communion lest they miss a chance at vitamins or minerals.

The teacher must turn to fact, to evidence from dentistry, medicine, all the contributing sciences. To select subject matter is, in itself, no easy task; and to get it accurate and scientific is almost equally difficult. One can well imagine the dilemma of the untrained teacher in the face of these hundreds of controversial and pseudoscientific practices.

17. Footnotes 6 and 8.

18. Footnote 11, Chapter 3.

19. Footnotes 12, 14 and 15.

These represent only four of the main factors involved in incorporating health work in the school curriculum. There are many others, ranging from legal complications to matters of propriety. Health education has been admitted to the field of education and now busies itself making its place firm and asserting its importance. It deserves the encouragement of all others interested in its development.

SUMMARY

1. Health instruction is not yet recognized as an integral part of the school curriculum, although relative values indicate that it should be.

2. Graduation credit should be given for health instruction, and colleges should require it as a unit of entrance.

3. The traditional subjects included in the usual sixteen recognized units for graduation from high school should be condensed or changed in some way to allow room for health education.

4. An already crowded curriculum does not justify the exclusion of health instruction.

5. In the first six grades, health should be taught by the classroom teachers. In the remaining six grades, the best work can be done by special teachers in a specific course. Correlation of health material with other subjects is desirable but is unreliable as the sole agent for health instruction.

6. All elementary school teachers in training and in service should be required to have an understanding of the teaching of health and of school health problems. This training can best be given in summer and by extension work to teachers in service.

7. Subject material for hygiene courses can best be made up of solutions to the health problems and interests of daily life. A judicious inclusion of adult problems will be helpful. Research, rather than empiric judgment, is the only reliable basis for the development of subject matter.

EFFECTS OF SOLUTIONS OF PROCAIN-EPINEPHRIN ON THE TISSUES OF THE PULP DURING LOCAL ANESTHESIA: HISTOPATHOLOGIC STUDIES

By ERIK HELLNER, Stockholm, Sweden

IN the year 1905, a German, Einhorn, synthetized procain as a substitute for cocain. In combination with synthetic epinephrin, "suprarenin," or the natural extract of suprarenal capsule, epinephrin, the employment of procain as a local anesthetic increased enormously, more especially in dental practice. No other local anesthetic has, even approximately, attained such extensive use as procain-epinephrin solution.

Above all, this is the case in Europe, where the dentists of a younger generation avail themselves extensively of procain-epinephrin, more especially in order to carry on their treatment of patients rapidly and painlessly, as regards not only the extraction of teeth but also all operations on the hard and soft tissues demanded in the treatment of carious processes. Assuredly there are in Europe dentists that very seldom, if indeed ever,

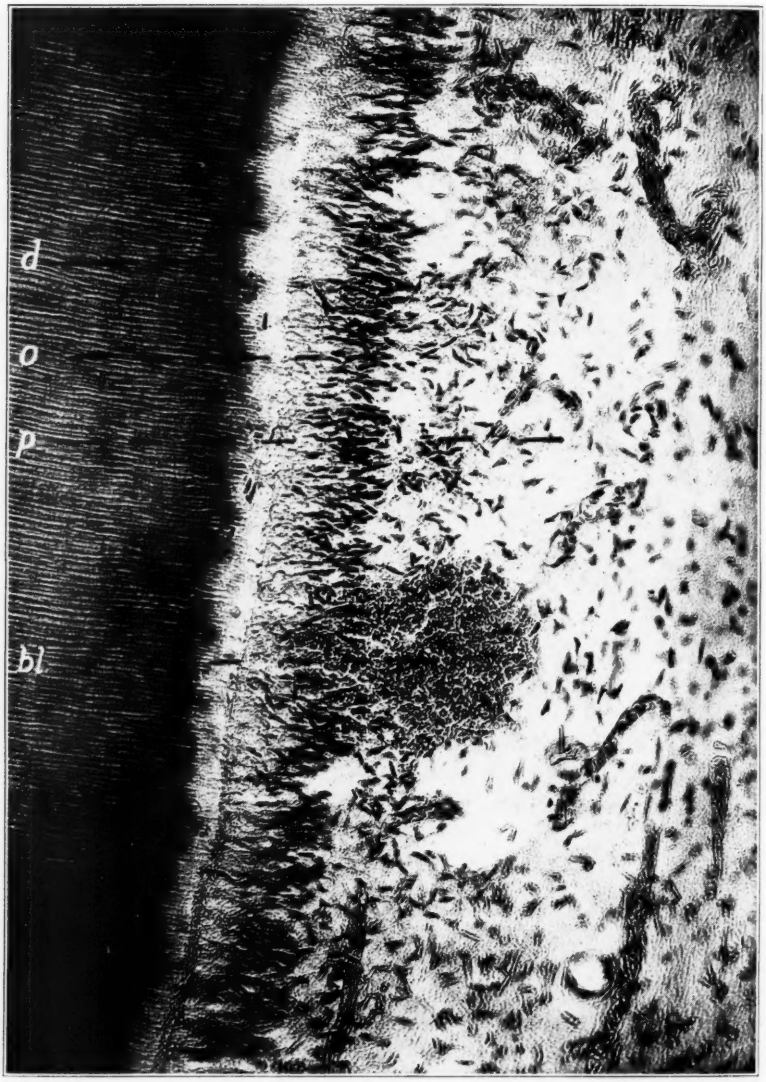

Fig. 1.—A typical picture of a pulp, the tooth being extracted from ten to fifteen minutes after injection with local anesthetics. There is bleeding in the vicinity of the odontoblastema, caused by a rupture of the capillaries. *d*, dentin; *p*, pulp; *bl*, bleeding; *o*, odontoblastema. (Hematoxylin-eosin; obj. 8 mm.)

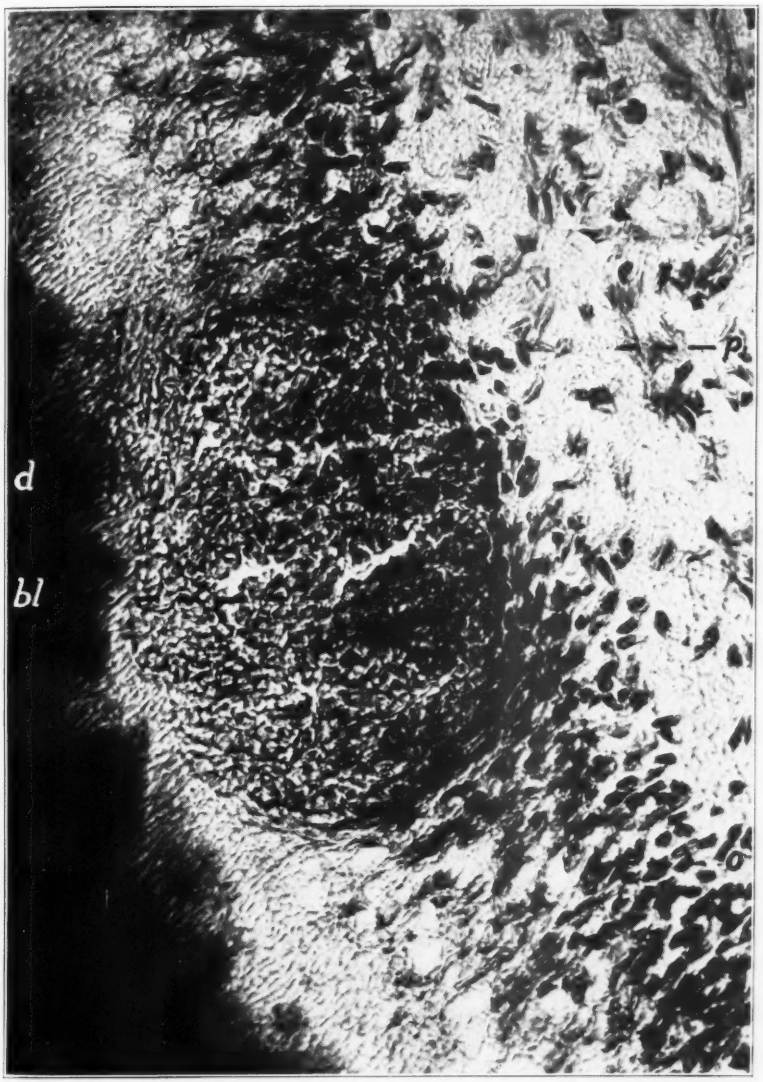

Fig. 2.—A typical picture of a pulp, the tooth being extracted from ten to fifteen minutes after injection of local anesthetics; high magnification. There is a fairly limited circumscribed area of bleeding in the odontoblastema caused by a rupture of a capillary. *d*, dentin; *p*, pulp; *o*, odontoblastema; *bl*, bleeding. (Hematoxylin-eosin; obj. 7 mm.)

undertake any treatment of the oral cavity without previous injection of procain-epinephrin. Often, during the course of treatment, the same tooth is subjected to repeated injections.

In the United States, from what I have read in periodical literature, procain-epinephrin is not so extensively used as in Europe. This is probably due to the fact that the American dentists have become familiar with the use of nitrous oxid and have found it a sure and infallible means of alleviating pain during dental operations. Nevertheless, there are certain signs that of late in the United States local anesthesia is slowly displacing nitrous oxid.

At the beginning of this century, in European dental literature, and more especially in the German periodicals, reports have been made of cases of necrosis of the pulp occurring during the first period of local anesthesia and due to injections of cocain and procain-epinephrin. This precipitated a heated discussion that affected the employment of local anesthesia in dental practice. Subsequent to investigations undertaken by Euler and Scheff, experimenting on animals, the conclusion was reached that no necrosis of the pulp, nor even any damage whatever, need be apprehended as a consequence of injection of procain-epinephrin, always provided a suitable quantity and proper dosage were employed. This also has become the general opinion.[1] *A priori* and theoretically, there are certain reasons to suppose that an injection of procain-epinephrin may, even if it does not cause necrosis, at least subject the pulp tissue of the tooth to certain pernicious effects that assuredly must cause a disturbance of its normal vital functions. The chief characteristic is that, besides eliminating sensibility, its content of epinephrin causes a considerable contraction of the vessels. The presence of more contractile elements in the arteries gives these vessels a greater power of contraction than have the veins. An abnormal blood pressure from the arteries into the capillary and venous system is the result of the effect of the epinephrin. Should there be no collateral circulation that can absorb and distribute the increased mass of blood and the increased blood pressure, but the evacuation of the blood is confined to the passage through a narrow foramen, bounded by firm and unyielding walls, the genesis of a similar area of high blood pressure within well-defined limits leads to bleeding both by diapedesis and, if the pressure be sufficiently powerful, by rhexis, i. e., rupture of the capillary walls.

The softer tissues of the pulp consist of a similar well-defined area, bounded by dentin devoid of collateral circulation; the discharge and supply being entirely dependent on the narrow passage through the foramen, or, more correctly, the apical foramina. The occurrence of intradental capillary or venous blood pressure is certainly no unusual thing in a tooth, owing to its anatomic and physiologic condition, but a probability bordering on certainty enables us to suppose *a priori* that, on injecting procain-epinephrin, a similar blood pressure occurs within the tissue of the pulp. It simply remains to be proved, by experimental investigation, whether this increased blood pressure may lead to the

1. There is a comprehensive account of this subject in an investigation published 1927 in Svensk Tandläkaretidskrift (The Swedish Dental Journal) entitled "Experimental and Histologic Investigations Concerning the Effects of Procain-Epinephrin Solution on the Living Tissues of the Human Pulp During Anesthesia After Injection, More Especially with Regard to Its Influence on the Vascular System of the Pulp."

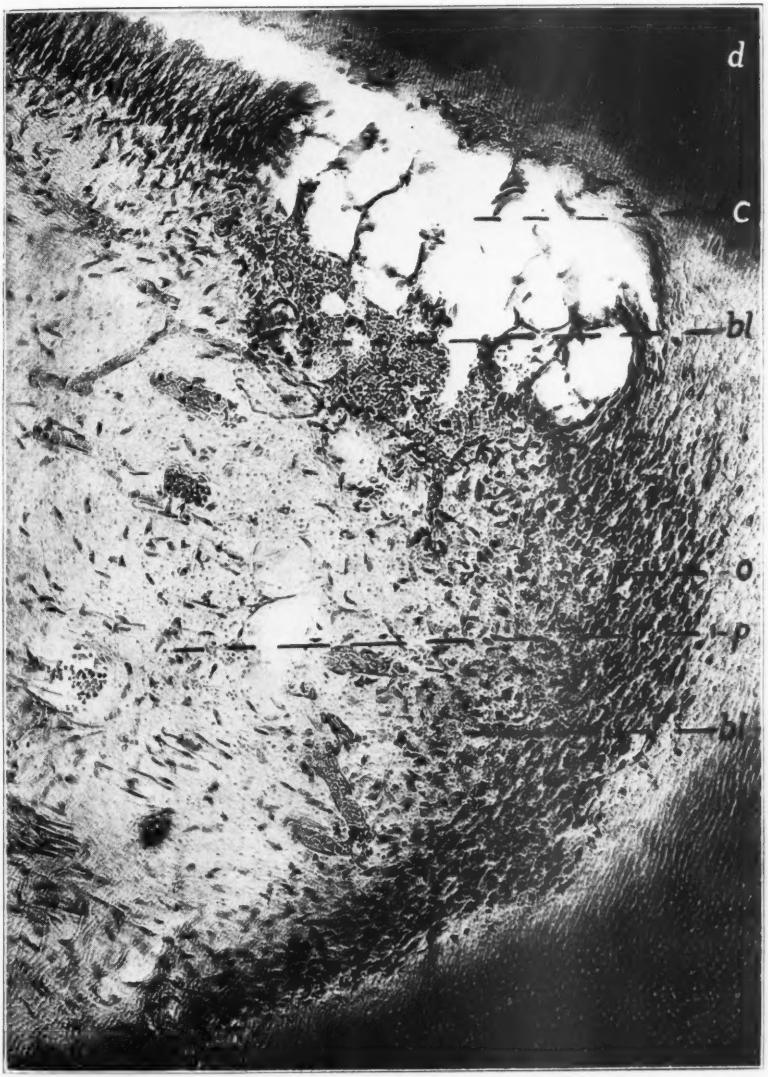

Fig. 3.—A typical picture of the pulp, the tooth being extracted from ten to fifteen minutes after injection of local anesthetics. Bleeding is caused by rupture of the capillaries. The cystic spaces that are filled with fluid are in this case very probably the results of previous injection. *d*, dentin; *p*, pulp; *o*, odontoblastema; *bl*, bleeding; *c*, cystic spaces filled with fluid; *b*, blood vessel. (Hematoxylin; obj. 8 mm.)

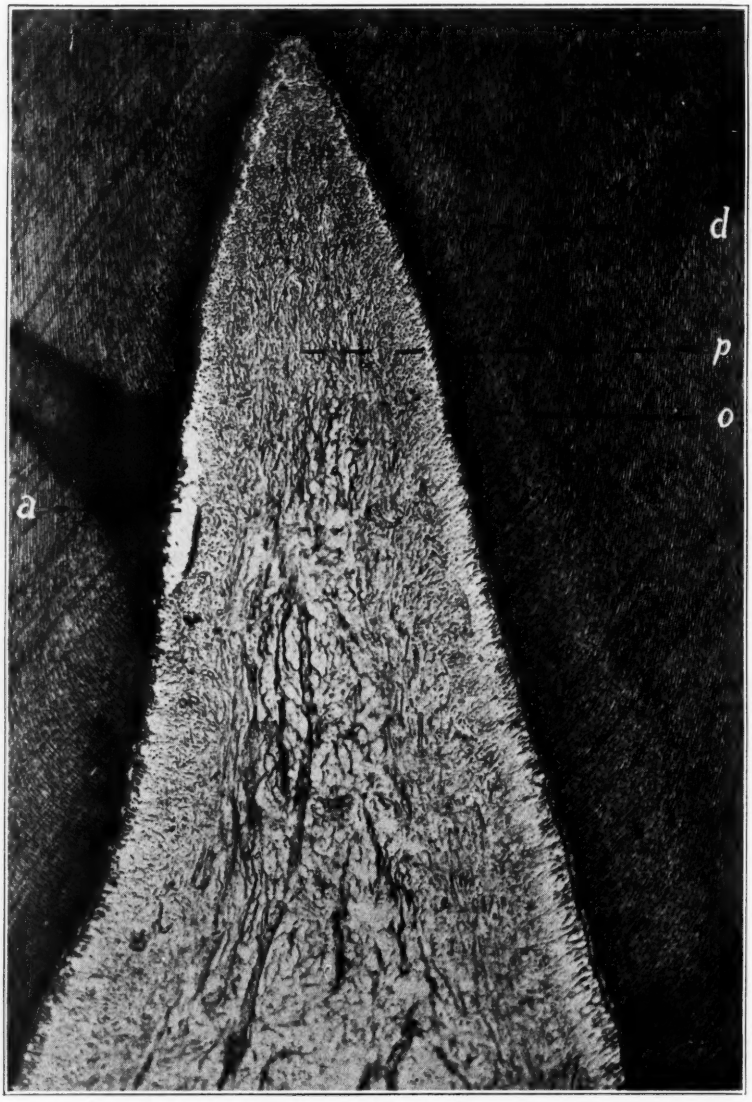

Fig. 4 (Case 1).—Section of upper right cuspid (control tooth). The regular odontoblastema is without vacuolation. *d*, dentin; *p*, pulp; *o*, odontoblastema; *a*, artefact. (Hematoxylin-eosin; obj. 16 mm.)

development of pathologic processes within the pulp.

In the pulp tissue, there is another area which may possibly also be influenced not so much by the increased intradental pressure as by the disturbed nutrition ensuing on injection. As we are aware, pulp tissues, subsequent to local injection of procain-epinephrin, appear to be completely anemic. On exposure, such a pulp lies like a white, bloodless strand in the pulp chamber. On piercing such a pulp strand, we find that it is not absolutely anemic, as it contains venous blood. This arterial anemia of the pulp tissue lasts for from one to two hours, i. e., the nutrition of the pulp is suspended for this space of time. The part of the pulp that may be influenced by interference with the nutrition is the layer of cells that provide the biologic function of the pulp: the formation of dentin, odontoblasts, or the odontoblastic layer, the "odontoblastema." The odontoblasts are highly differentiated cells, and, according to the opinion held in general pathology, the more highly differentiated the cells of an organ are, the more readily are they subject to necrosis by disturbed nutrition. For instance, the cells of the brain die rapidly on such occasions: the epithelium of a kidney presents a turbid dilation after an anemia that lasts for an hour; after two hours, an extended fatty degeneration, and, after a still longer time, necrosis.

The odontoblasts are undoubtedly most highly differentiated among the cells forming hard substance. On investigating the pulp tissues of intact teeth, we seldom find a fully normal or what may be considered a normal odontoblastema.[2] Vacuolation was present with remarkable frequency in the odontoblastema. Certain degenerative and atrophic phenomena in the cell layer are very common. In all probability, we may consider that the odontoblasts are specially sensitive to both exogenous and endogenous irritations. Among the conditions that might cause a diminution of the odontoblastema's vitality we must naturally include interference with nutrition. Cutting off the supply of blood to the tissues of the pulp of a tooth for a longer or shorter period might cause histologically visible alterations of the odontoblastema that certainly might be regarded as the result of the anemia producing effects of the injection of procain-epinephrin. A summary of the investigations carried on during 1927 with regard to this subject will now be given. A detailed description of the subject connected therewith will be found in the periodical already mentioned.[1]

Examination of about thirty intact or only very slightly carious human teeth that were treated with supraperiosteal injections of 2 and 5 per cent procain-epinephrin (epinephrin in 1:1,000 solution, one drop to 1 c.c.) with subsequent exposure of the pulpal tissue, which is sharply pierced, have proved that a pulp during anesthesia contains only venous (dark red) blood. This arterial anemia generally lasts for about an hour, sometimes less, and at times for two hours.

The microscopic examination of about twenty intact human teeth (examination of similar control teeth, all of them intact, but treated without injections, was also made) that had been subjected not only to supraperiosteal injections, in the preponderant number of cases investigated, but also to mandibular anesthesia, has proved to me that the intradental blood pressure, increased by the injection,

2. Blastema: a continuous differentiated layer of cells partaking in the formation of hard tissue; odontoblastema: the layer of odontoblasts.

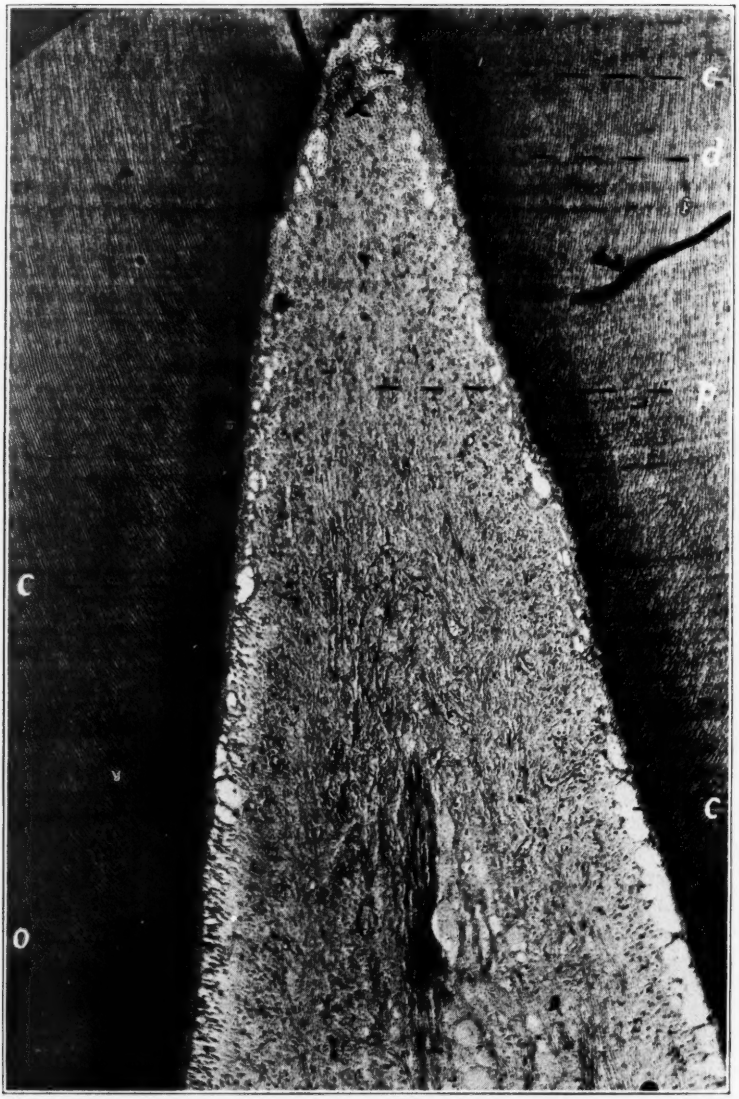

Fig. 5 (Case 1).—Section of upper left cuspid, the injected tooth. The picture is from one of the cuts in the series, representing a corresponding position to that of the picture of the control tooth. The difference in the appearance of the odontoblastema is to be noted. *d*, dentin; *p*, pulp; *o*, odontoblastema; *c*, partial cystic destruction of the odontoblastema by collections of fluid. *x*, area which is shown in higher magnification in Figure 6. (Hematoxylin-eosin; obj. 16 mm.)

Fig. 6 (Case 1).—Section of upper left cuspid (higher magnification of area *x*, Figure 5); cystic edematous destruction of the odontoblastema. *d*, dentin; *p*, pulp; *f*, predentin; *o*, odontoblastema; *c*, cystic edematous destruction of the odontoblastema.

causes hemorrhages by diapedesis, but also by rhexis, as well as edema. Those teeth destined for examination were extracted from fifteen to sixty minutes subsequent to the injection of from 2 to 5 per cent procain-epinephrin (drop of epinephrin in 1:1,000 solution to 2 c.c. of procain solution).

The bleeding that could be ascertained by the microscope was chiefly localized in the odontoblastema; but in other portions of the pulp, similar pathologic processes were observable.

As it might be conceivable that capillary rupture was a consequence of a tear in the tissue of the pulp, which may well be imagined to occur when the tooth is extracted, the excessively distended capillaries, owing to the injection, may easily be imagined as bursting under the strain of extraction, the pulp being partly anchored in the dentin by Tome's fibrils. Extraction was also undertaken twenty-four hours after injection; and, after that, no injection was made immediately previous to extraction. The same pathologic processes have been observed under the microscope in the control experiments.

The eventual alteration of the odontoblastema (degeneration necrosis) cannot be proved histologically by these investigations, the time elapsing between the injection and the extraction of the tooth and its fixing being too brief. In order to prove such eventual alterations, it would be necessary to allow one day or even several days to elapse between the injection and the extraction of the tooth and its fixation. Accordingly, my investigations hitherto published also include histologic examination of teeth extracted from one to ten days subsequent to an injection. These investigations, which include about twenty intact human teeth, with controls in each case, in some instances prove an incipient resorption of blood in the pulp, caused by the injection, owing to typical cell activity in similar pathologic processes. They prove furthermore a hydropic degeneration of the odontoblastema, and, in certain instances, that it was necrosed. In one case, total necrosis of the pulp occurred as a consequence of injection of procain-epinephrin.

The results obtained by the investigations undertaken are as follows:

1. Injection of procain-epinephrin solution causes a marked venous and capillary hyperemia, the result of more powerful contraction of the arteries as compared with that of the veins, the contraction driving blood into the capillary and vascular system. Owing to the contraction that simultaneously occurs at the apex of the larger veins, discharge of blood from the tooth is prevented.

The capillary and venous system must, in normal circumstances, absorb the entire quantity of blood present in the vascular system of the pulp.

2. The maximal distension of the capillaries and veins, caused by the hyperemia, occasions rupture of the vascular walls, especially those of the capillaries. Extravasation of blood into the surrounding tissues, particularly into the odontoblastema, is a consequence thereof. Bleeding by diapedesis and also by rhexis was also observed; which points to a considerable degree of stasis.

3. Edema occurs in the pulpal tissues, especially in the odontoblastema and the horns of the pulp. The transudation and hemorrhages have a very destructive effect on those portions of the pulp affected thereby.

4. In several instances, the cells of the odontoblastema lying nearest to the dentin have assumed a necrobiotic character, with no or but slight staining of the nucleus. A seam of similar necrobiotic

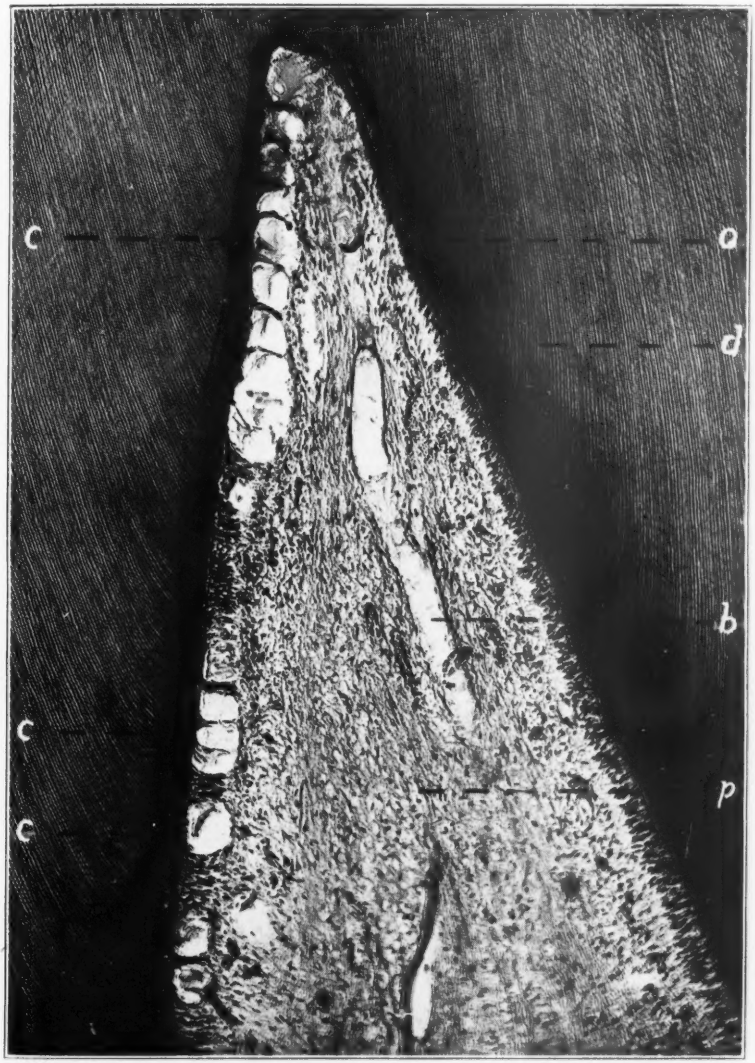

Fig. 7 (Case 2).—Section of upper second bicuspid. *d*, dentin; *p*, pulp; *o*, odontoblastema; *c*, cystic destruction of the odontoblastema; *b*, blood vessels. (Hematoxylin-eosin; obj. 16 mm.)

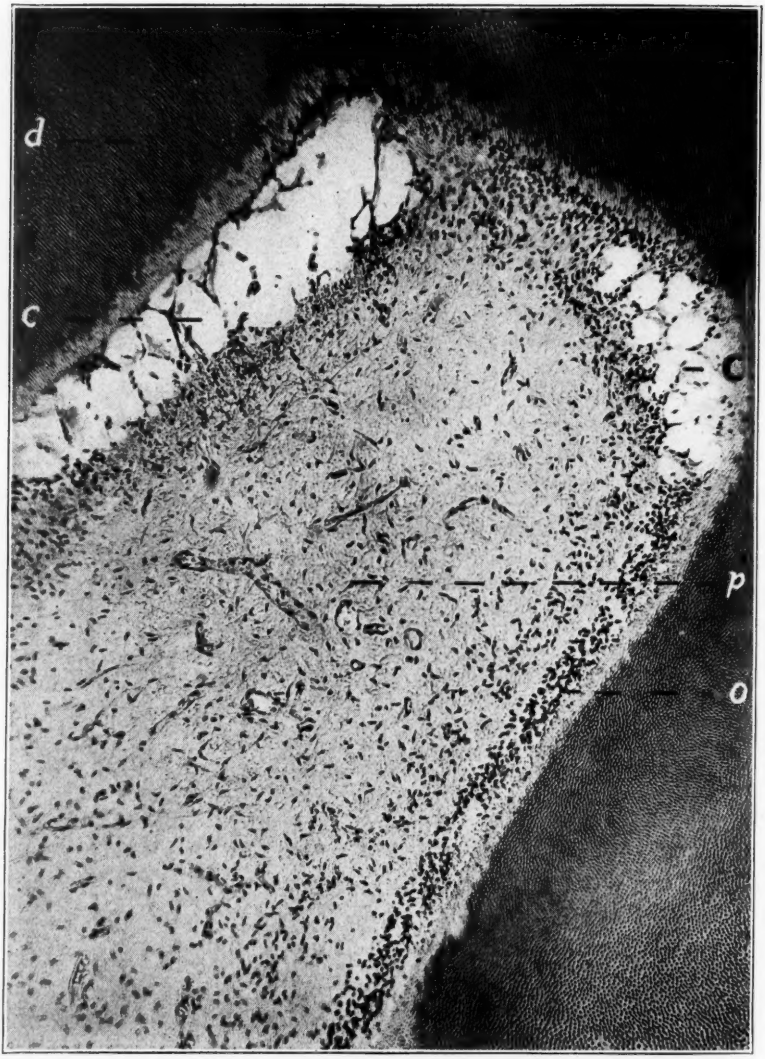

Fig. 8 (Case 3).—Section of upper right second bicuspid; cystic destruction of an odontoblastema. *d*, dentin; *p*, pulp; *o*, normal odontoblastema; *c*, cystic destruction of the odontoblastema. (Hematoxylin-eosin; obj. 16 mm.)

cells often forms the outer limit of the pulp tissues. A vacuole degeneration of the nuclei of the odontoblastema is often observable; while, frequently, a displacement of the nucleus toward the margin of the cells may be noticed.

5. In those pulps in which, from any cause, hyperemia has previously occurred, extensive bleeding has been observed. In those pulp tissues that were previously anemic, on the other hand, the bleeding proved minimal. It appears that the odontoblastema of the latter pulp tissues have suffered degeneration to a far greater extent.

6. Procain in higher concentration appears not to exercise a more pernicious influence on the cells of the pulpal tissues or the vascular system than did the lower concentration.

7. Whether the pulpal tissues are by generation entirely able to recover from the effects of an injection cannot, with any certainty, be proved by this investigation. For this purpose, it would be necessary that the experiments be continued for a longer period. In some of the instances investigated, it appears that a similar regeneration *in toto* was not possible. By continued research work in this subject, I hope to succeed in solving this question.

During the year 1928 and a part of 1929, I continued my investigations on conditions that are a consequence of administration of dental local anesthetics. My investigations are not as yet definitely finished, but the results hitherto obtained are of such a character that I believe they deserve interest.

I shall first say a few words regarding the technic used in the experimental work.

In order that this kind of investigation may be given scientific value, the use of controls is in most cases absolutely necessary.

Not until we have in a number of cases been able to ascertain structural differences in the pulpal tissues of the experimental tooth and the control tooth, differences that thus only can be ascribed to the treatment, are we justified in using, in single cases, only one tooth in our experimental investigations, and, if similar changes are noticed in this tooth, in ascribing the origin of these changes to the treatment.

But also in the use of control teeth, which in most cases is absolutely necessary, we meet certain difficulties when trying to ascertain the changes referable to the influence of a certain definite factor that has been introduced; in this case, to the injection. In teeth belonging to adults, we seldom find, it is true, a normal, regular odontoblastic layer. We may, of course, assume that, in the course of years, on account of exogenous or endogenous factors, approximately the same odontoblastic changes occur in intact teeth in the same individual; but that this really is the case can as yet not be taken for granted. In order to avoid faulty interpretations, which might be the consequence of such a condition, I have, in my later experimental work, made use of intact teeth of young individuals, generally under 15 years of age, and then, as a rule, of corresponding teeth in the other half of the arch. Thus, the upper right cuspid becomes the experimental tooth, the upper left cuspid, the control, the upper right second bicuspid, the experimental tooth, the upper left second bicuspid, the control tooth, etc. We have then the advantage of a generally regular, exceedingly vital odontoblastic layer, owing to the fact that the tooth is still, as it were, in a physiologic state of development. In these experimental teeth,

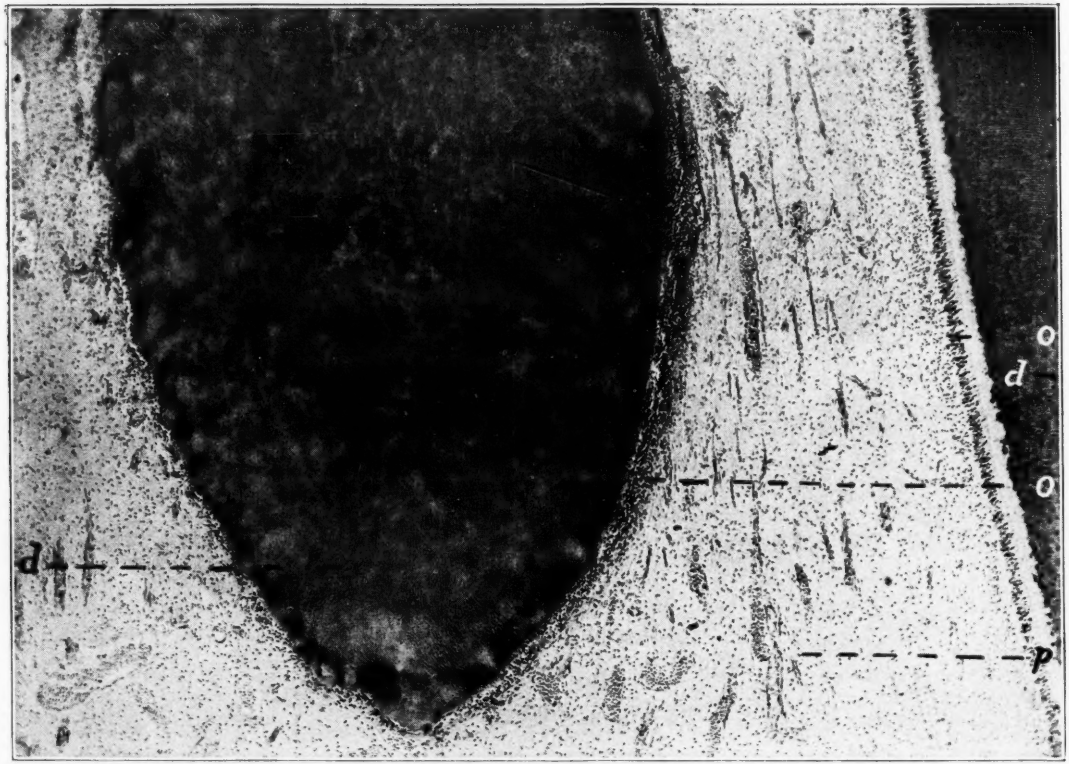

Fig. 9 (Case 4).—Section of upper left second bicuspid (control tooth); from the floor of the chamber of the pulp and the openings of the root canals into the chamber of the pulp. The regularly formed odontoblastema covers the dentinal wall. *d*, dentin; *p*, pulp; *o*, odontoblastema. (Hematoxylin-eosin; obj. 2 mm.)

blastema. (Hematoxylin-eosin; obj. 2 mm.)

Fig. 10 (Case 4).—Section of upper right second bicuspid, the injected tooth. This picture is from a cut in the series, representing a corresponding position to that of the picture of the control tooth. The cystic cavities have replaced the odontoblastema. *d*, dentin; *p*, pulp; *c*, cystic destruction of the odontoblastema; *l*, collections of leukocytes. The areas shown at x_1, x_2 and x_3 are shown in higher magnification in the pictures following. (Hematoxylin-eosin; obj. 2 mm.)

changes that may take place are easier to point out. This also applies to the vascular system in the pulp which, in general, is especially well developed in young individuals.

The material necessary for my investigations has been placed at my disposal by the head of the orthodontia department of the Stockholm Dental Institute, Axel Lundström, to whom I wish to express my gratitude for valuable assistance. The teeth used should in any case be removed for orthodontic purposes. Generally, the teeth of the upper jaw have been used.

At one of those teeth, supraperiosteal injections were made, labially and palatally, in the vicinity of the apex. Solutions of 2 per cent and 3 per cent procain-epinephrin have been used in all cases, with the same percentage of epinephrin, at most 1 drop to 1 c.c. The composition of the solution has been as follows: Solution 1: Procain, 2 c.c.; sodium chlorid, 0.92 c.c.; distilled water to make 100 c.c. Solution 2: Procain, 3 c.c.; sodium chlorid, 0.86 c.c.; calcium chlorid, 0.02 c.c.; distilled water to make 100 c.c.

The amount injected has been 1, 2 or, at most, 3 c.c. for each tooth. It has not been possible to prove any apparent difference as regards the composition of the solution or the amount injected, with reference to their influence on the structure of the pulp tissue.

The time that elapsed between the injection and the extraction of the tooth has, in these later investigations, now published for the first time, varied between two weeks and two months.

The preparation of the histologic slides has been effected by means of the technic commonly used at the Histopathologic laboratory of the Dental Institute in Stockholm: fixing in 20 per cent formaldehyd-compound (formaldehyd-corrosive mercuric chlorid) and treatment with trichlorid acetic acid. The stains that have been made use of are hematoxylin-eosin; Hansen's stain connective tissue; in certain cases, thionin and in some cases methylene blue and Giemsa's stain. Serial sections of the different teeth, about 100 for each tooth, have in every case been prepared. The thickness of the sections has varied between 8 and 10μ.

A record has been kept for each case, in which have been entered the age of the individual, the history of the case, with past or present illnesses, the main dietary, especially with reference to the presence of vitamin C in the food, the extent of caries, the occlusion of the teeth, etc. These statements can be given only comparatively slight value as regards past or present illnesses and biochemical conditions. But they have a certain significance, even though comparatively small in this connection, especially as regards the presence of vitamin C in sufficient quantity in the food, or its eventual absence. The influence of vitamin C on the tooth is, at present, as is well known, a point of great interest in dental research, and in most future histologic investigations made on teeth, the biochemical condition of the individual will undoubtedly play a prominent part in an estimate of the relative or absolute value of the investigation.

As is known, a pronounced lack of vitamin C has a destructive influence on the pulp tissue, especially on the odontoblastic layer (Westin, Kotanyi, Zilva, Robbs and others). Viewed in this connection, the importance of the control tooth is all the more evident. Microscopic changes in the appearance of the teeth, the pulp and the hard tissue, due to biochemical conditions, naturally affect the denture as a whole, and not single teeth, though possibly more or less marked in intact teeth of the same in-

Fig. 11 (Case 4).—Section of upper right second bicuspid (higher magnification of the area x_1 in Figure 10). The odontoblastema is entirely destroyed and replaced by cystic cavities filled with fluid. *b*, blood vessels. (Hematoxylin-eosin; obj. 8 mm.)

Fig. 12 (Case 4).—Section of upper right second bicuspid (higher magnification of the area x_2 in Figure 10). *d*, dentin; *c*, cavity of cystic character filled with fluid; *l*, disintegrating leukocytes; *n*, necrotic area of remains of nuclei and disintegrating erythrocytes. (Hematoxylin-eosin; obj. 8 mm.)

dividual. It is unnecessary to go into the changes that certain biochemical conditions may bring forth. I refer to the literature already available.

The latest investigation made, comprising about twenty cases, has for its purpose the establishment of the further development of pathologic processes that occur in the pulp after injections of procain-epinephrin. The changes that can be noted, as has previously been stated, are the occurrence of edema, and frequent bleeding, especially in the odontoblastic layer. Thus, it is above all the dentin forming cells, the odontoblasts, that first suffer from the pathologic processes caused by the injection.

The further development of these biologic processes in the pulp tissue can, of course, be imagined to proceed toward regeneration, when the blood is resorbed. The existing primary pulp cells eventually proliferate into new odontoblasts after a longer or shorter period of time; or a further destruction of the odontoblastic layer can be imagined to take place, with complete destruction of larger or smaller parts of this cell layer. It can even now be said that a period of two months is too short a time for proving that any regeneration takes place. The processes of regeneration generally occur in the pulp with an extreme slowness, undoubtedly dependent on purely circulatory conditions.

From my available material, I have chosen a number of typical cases, of which a further account is given below.

For the sake of continuity and in order to get a clearer and better conception of the development of the pathologic processes, I shall, in the following, reproduce from my previously quoted work a number of pictures and descriptions, which illustrate the immediate influence of the injection on the pulp. (Figs. 1-3.)

REPORT OF CASES

Case 1.—A girl, aged 14, who had had protruding upper cuspids extracted, for orthodontic reasons, showed remarkably little caries. Only the first permanent molars were treated. The general health was perfect, and fruit (apples, oranges) were included in the daily diet.

Oct. 21, 1927, injection was made at the upper left cuspid of 3 c.c. of a 2 per cent solution of procain-epinephrin (solution 1).

October 28, both upper cuspids were extracted (the control tooth without injection).

Microscopic Examination.—The control tooth (Fig. 4) had a large pulp. Through the wide apical foramen, the thick periodontium could be seen, extending into the root canal. The pulp began with a rather distinctly marked border; but strong filaments of collagen along the inner wall of the canal formed a transition between the paradentium and the pulp. The pulp consisted to a great extent of collagen, and was thus almost a fibrous type of tissue. By reason of the almost absolute absence of pulp cells proper, and a considerable percentage of collagen, not much of the embryonic type of tissue of the pulp remained.

In the center of the pulp was found a rather extensive reticular atrophy. The tissue contained numerous vessels, and especially in the vicinity of the odontoblastic layer, capillaries were to be found in great numbers.

Especially in the lower part of the root canal, the collagen fibrils had been condensed into masses which, in some places, entirely filled up the root canal.

A peculiarity which, in the first place, attracted the attention is the relation between the odontoblastic layer and the predentin. The appearance, extent, etc., of the predentin was, of course, to a certain extent an indication of the condition of the odontoblastic layer, and could, from that point of view, give valuable information.

A very narrow zone of predentin was found everywhere in the pulp chamber, and the upper third of the root canal. The number of dentinal tubuli appeared to be normal.

As regards staining, the odontoblastic layer did not belong to the highly vital type with rounded and well-stained nuclei. On the contrary, the nuclei were elongated and their outlines more diffuse, and hydropic vacuolation in the cell elements could often be observed. The absence of single blastic cells

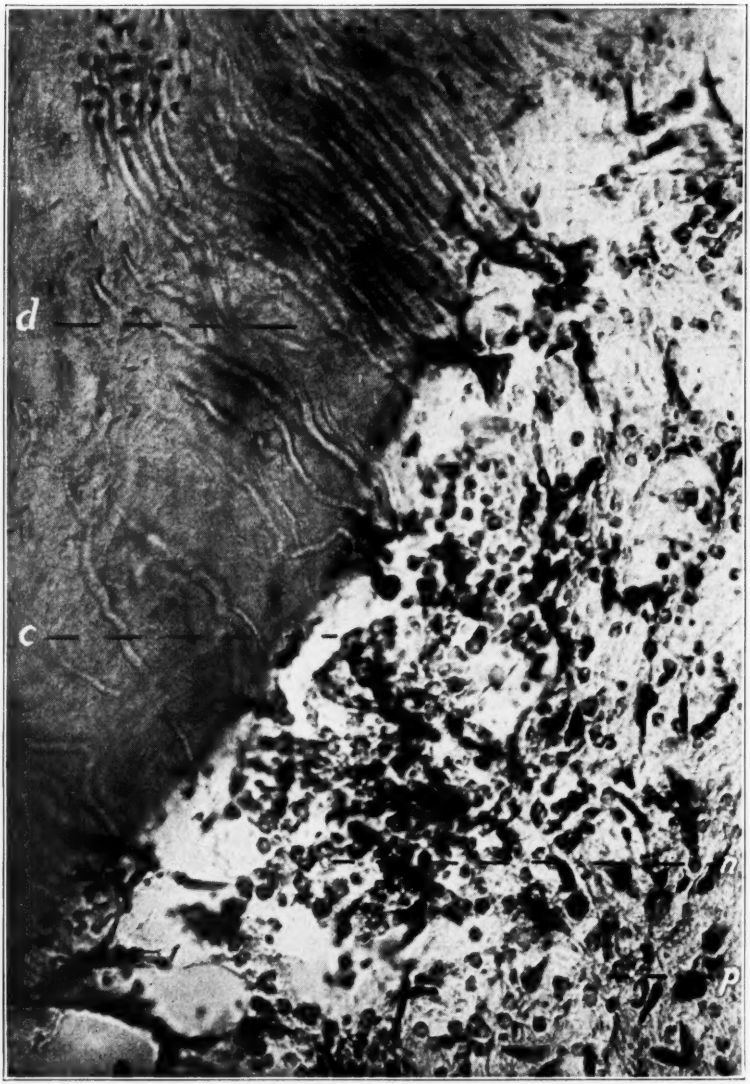

Fig. 13 (Case 4).—Section of upper right second bicuspid (higher magnification of the area x_3, Figure 10). The destruction of the odontoblastema is complete. *d*, dentin; *p*, pulp; *c*, collections of fluid replacing odontoblastema; *n*, necrotic areas of remains of nuclei and disintegrating erythrocytes. (Hematoxylin-eosin; obj. 7 mm.)

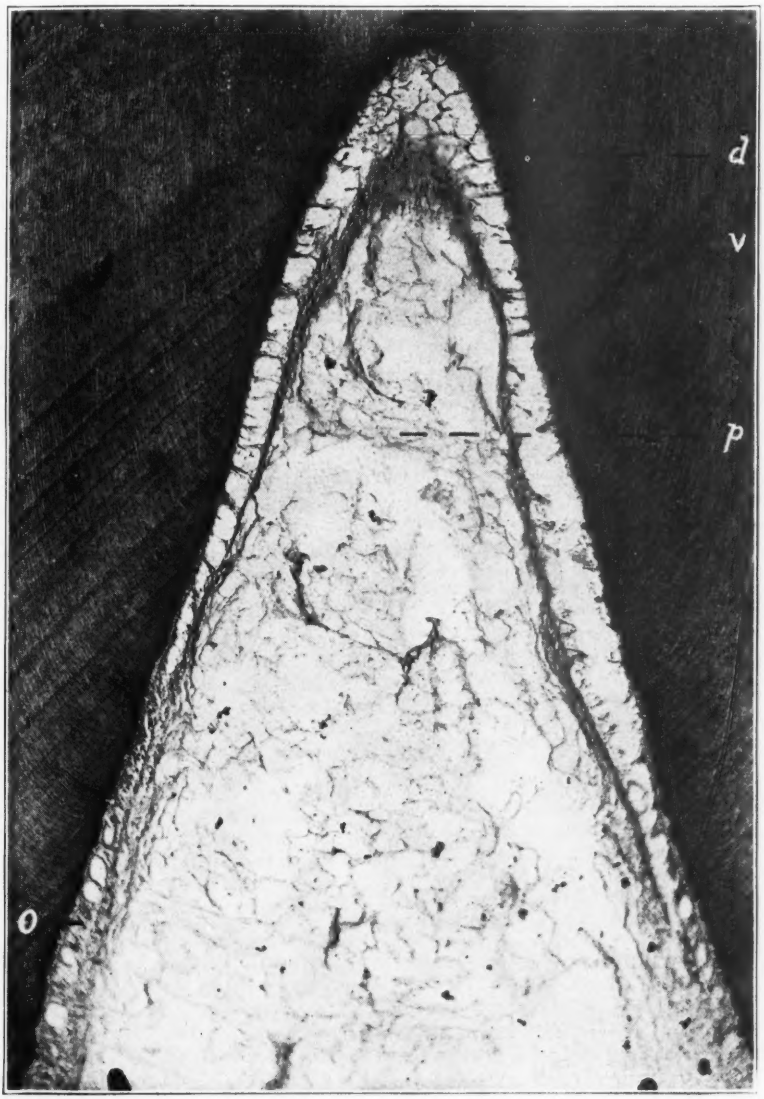

Fig. 14 (Case 5).—Section of upper right cuspid (control tooth). The pulp shows pronounced reticular atrophy and an extensive vacuolation of the odontoblastema. *v*, vacuolation in the odontoblastema. (Hematoxylin-eosin; obj. 16 mm.)

can only seldom, and in exceptional cases, be proved.

Phenomena of a more pathologic kind, such as bleeding, cell infiltration and edema, could not be observed.

On account of its exceptional abundance of collagen, its highly fibrous type of tissue and its odontoblastic layer of unusual appearance, this type of pulp could not be said to belong to the one most commonly met with in younger individuals. For one reason or another, its appearance deviated considerably from the embryonic type of pulp-tissue.

The injected tooth (Figs. 5 and 6) showed pulp-tissue corresponding with that of the control tooth. Thus, there were the same marked quantity of collagen, the same topographic conditions in the apical part of the root canal, the same reticular atrophy in about the center of the pulp; and the system of vessels seemed to be rather well developed but with a marked hyperemia. The part of the paradentium which remained attached to the tooth during extraction showed a pronounced hyperemia.

With regard especially to the odontoblastic layer, we could, in comparison with the control tooth, see certain marked differences. The changes which affected the odontoblastema, i.e., the odontoblastic layer, undoubtedly as a result of the injection, were, according to what can be proved, the following: The area at the apex of the pulp along the dentinal wall was edematous; and this edema led to the appearance of cystic cavities filled with fluid, sometimes partly limited by remaining blastema cells.

In general, the appearance of these edematous formations brought about the destruction of the odontoblastic layer. This edematous area often extended beyond the preexistent blastema area proper. Remains of disintegrated blood-corpuscles were also present. An increase of fibroblastic elements and the occurrence of plasma cells could be noticed as a tissue-reaction. On the other hand, leukocytes did not occur.

The remaining nuclei of the blastema cells often showed a very reduced stain. A hydropic vacuolation of the nuclei was a frequent occurrence.

Case 2.—A boy, aged 14, had a nonocclusion and lingual malocclusion of the upper left second bicuspid. Besides that, the case presented nothing of interest.

Nov. 27, 1928, injection was made at the offending tooth of solution 2 (2 c.c.).

December 19, extraction of the tooth was made after injection of 2 c.c. of 2 per cent procain-epinephrin.

Microscopic Examination.—The pulp tissue was of a distinctly embryonic type and very hyperemic. In the coronal part, there was no formation of collagen whatever; but in the root canals, there are numerous filaments of collagen. In the immediate vicinity of the normally developed odontoblastema, were found areas of cystic character filled with fluid. (Fig. 7.) The occurrence of these spaces had naturally caused a destruction of single blastema cells. The occurrence of bleeding by diapedesis and by rhexis of typical appearance in teeth extracted after previously given injection is rather frequent. Also edematous formations inside the pulp are not uncommon. They often occur in the vicinity of cavities of cystic character in the odontoblastema (Fig. 7).

Case 3.—A boy, aged 14, had labial malocclusion of the maxillary cuspids. For orthodontic reasons, the upper second bicuspids were to be extracted.

Feb. 4, 1929, injection was made at the right upper second bicuspid of 2 c.c. (solution 1).

March 18, extraction was made of the left upper second bicuspid (control tooth) and the right upper, with injection.

Microscopic Examination.—The control tooth showed a pulp of an exceptionally distinct embryonic tissue type, very hyperemic and with well-developed odontoblastema and predentin. Vacuolation in the odontoblastema was nowhere discernible. Bleeding of the character commonly found in injected teeth, which are extracted immediately after the injection, could be seen in different places.

The injected tooth showed a pulp tissue of the general type and appearance of the control tooth. The odontoblastema showed important differences. It had been partially destroyed by the formation of cystic cavities filled with fluid. In the neighborhood of the borderline formed by these cystoid cavities against the pulp tissue, we frequently found remains of nuclei and disintegrating red blood corpuscles. Collection of lymphocytes and similar cell elements was considerable at several places. (Fig. 8.)

Case 4.—A girl, aged 12, gave a history revealing nothing of special interest.

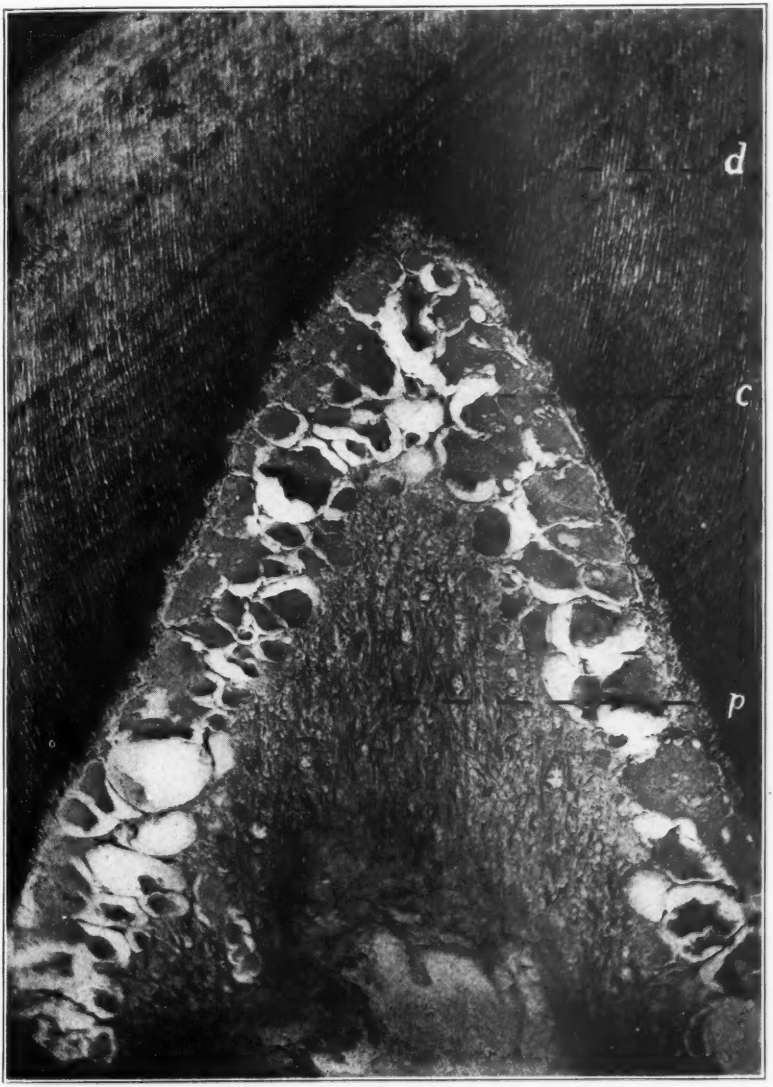

Fig. 15 (Case 5).—Section of upper left cuspid (injected tooth). There is extensive and pronounced staining of the transudate. *d*, dentin; *p*, pulp; *c*, coagulated serum. (Hematoxylin-eosin; obj. 16 mm.)

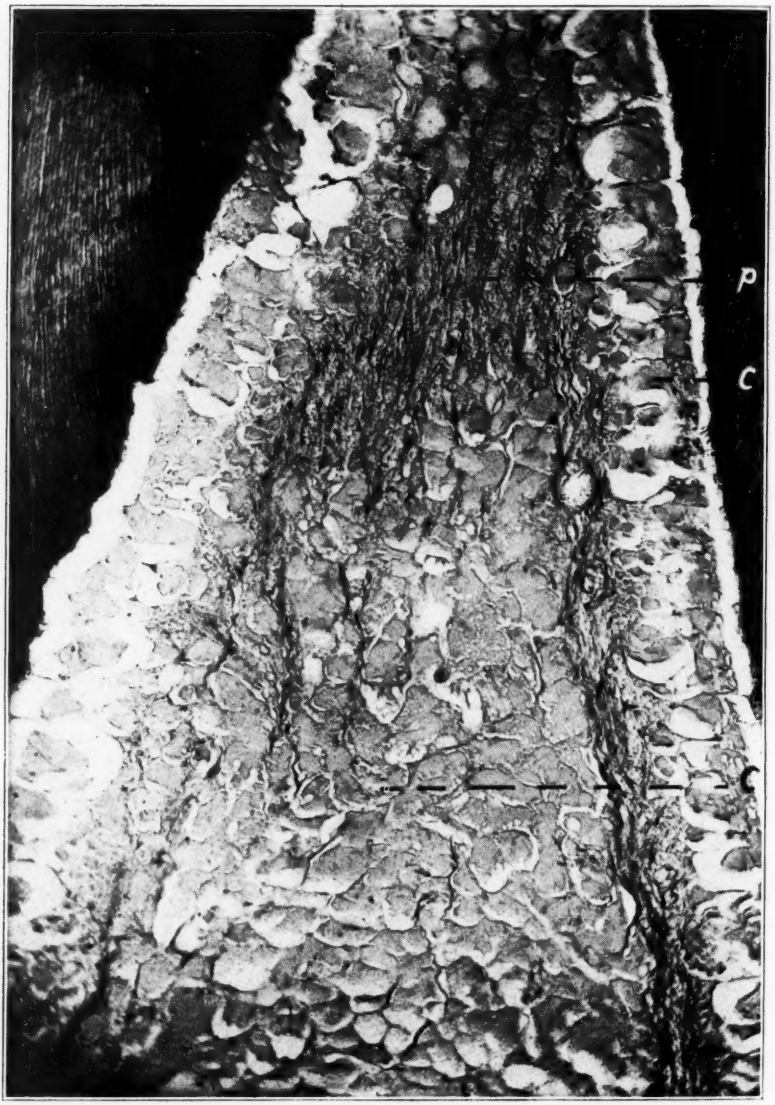

Fig. 16 (Case 5).—Section of upper left cuspid. There is considerable extension of the edematous formations. *p*, pulp; *c*, coagulated eosin-colored serum. (Hematoxylin-eosin; obj. 16 mm.)

Feb. 4, 1929, the upper second bicuspids were extracted for orthodontic purposes. They were intact, in occlusion and articulating.

Injection was made at the right of 2 c.c. of procain-epinephrin (1 drop of epinephrin) (solution 1).

March 4, extraction was made of both teeth under ether anesthesia.

Microscopic Examination.—The pulp tissue of the control tooth (left) was of an exceptionally distinct embryonic tissue type. There was a particularly well-developed odontoblastema, with no vacuolation appearing in any specimen; also, a complete, well-developed zone of predentin except in the bottom of the pulp chamber and at the orifice of the root canals, where the appearance of the dentin was irregular, predentin was lacking and the odontoblastema was atypical. The different elements of tissue took the stains exceedingly well everywhere. (Fig. 9.)

The injected tooth (right) showed a pulp tissue, on the whole, of the same appearance and type as that of the control tooth. The odontoblastema showed certain important differences. A considerable destruction of the odontoblastema had occurred, especially in the bottom of the pulp chamber and at the openings of the root canals in the chamber. This destruction had taken place because of the occurrence of cavities of cystic character. (Figs. 10-13.)

In and around these above mentioned cavities, numerous free disintegrating blood corpuscles appeared, i.e., remains of nuclei; also disintegration of leukocytes was seen. (Figs. 12-13.) These leukocytes were apparently being dissolved. The contour of the cell was very indefinite and the nucleus very difficult to stain.

Case 5.—A girl, aged 11, perfectly well according to her own statement, but appearing to have a weak constitution, had all the teeth except the third molars. The teeth were remarkably unaffected by caries. The upper cuspids were only partly erupted labially, and consequently neither occluded nor articulated. The lower left cuspid was in slight labial malocclusion as well as in articulation.

Sept. 26, 1927, injection was made at the upper left cuspid of 2 per cent procain-epinephrin (solution 2) 3 c.c. (3 drops of epinephrin). Injection was made at the lower left cuspid of the same amount of the same solution.

The upper right cuspid (control tooth) was extracted the same day without anesthesia.

October 17, extraction was made of the upper and lower left cuspids after injection.

During the interval, the patient stated that she had toothache two or three days after the first injection made.

Microscopic Examination.—The control tooth (upper right cuspid) showed a pulp tissue the appearance and type of which very essentially deviated from the type that, to a very large extent, we are used to denote as the normal one, and which we above all expect to meet in young individuals. For some unknown reason the pulp tissue in this case had suffered considerable pathologic change. The coronal part offered a fine illustration of the so-called reticular atrophy of the pulp. The original embryonic pulp cells were totally missing. The tissue consisted of a particularly loose rhomboidal connective tissue with collagen elements. At the coronal extremity of the pulp tissue, the odontoblastema was almost entirely lacking. Large vacuoles were found. (Fig. 14.) In the remainder of the coronal part, there was found what may be called a condensed odontoblastema, but with vacuolations here and there.

In the root portion of the pulp, an entire change of the type of pulp tissue had set in. Neither did we find any remains of the original, embryonic type of tissue. Original pulp cells and odontoblasts did not exist. The tissue consisted of a particularly condensed mass of collagen fibrils going in the direction from the apex to the crown. The zone of predentin had here disappeared. It was found in the coronal part.

Any direct acute pathologic changes such as cell infiltration, bleeding or disintegration of different tissue elements could not be found. Of the injected teeth, the upper left cuspid showed the type of pulp tissue corresponding on the whole, with that of the control tooth. The odontoblastema showed considerable differences. At the coronal extremity of the pulp, sections stained with hematoxylin-eosin were found, i.e., eosin-colored collections of fluid, which not only had filled eventually preexisting vacuoles but also had become so extended, that they had practically filled the whole coronal extremity of the pulp. (Figs. 15-16.) In the other parts of the pulp tissue, we notice large cystic

Fig. 17 (Case 5).—Section of upper left cuspid. *d*, dentin; *c*, cystic cavities partly filled with coagulated serum. (Hematoxylin-eosin; obj. 7 mm.)

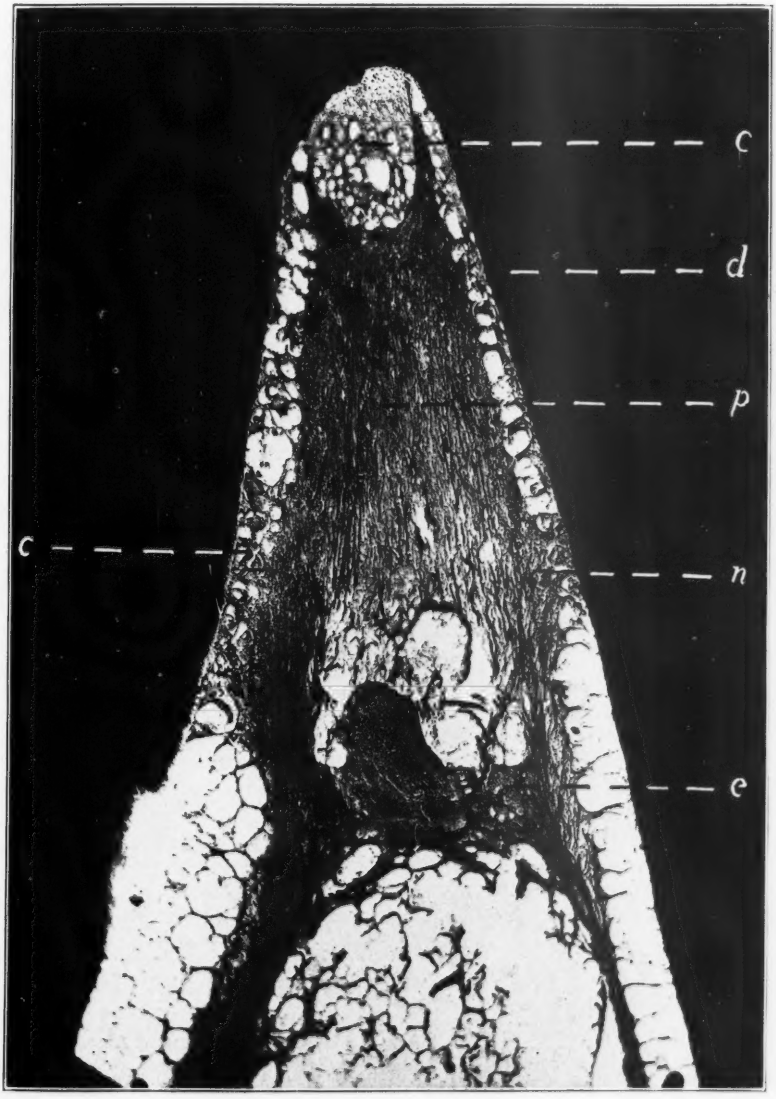

Fig. 18 (Case 5).—Section of lower left cuspid. *d*, dentin; *p*, pulp; *n*, necrotic area consisting of remains of nuclei and disintegrating erythrocytes. *c*, cystic cavities partly filled with coagulated serum; *e*, considerable collection of coagulated serum . (Hansen's stain-trioxyferrihematin; obj. 16 mm.)

cavities, especially in the odontoblastema. (Figs. 15-17.)

In the lower left cuspid, as may be seen from the illustrations of this tooth, we can prove the occurrence of about the changes found in the upper left cuspid, as a result of the injection. (Fig. 18.)

Besides these cases described in detail, about fifteen other experimental examinations have been made, mostly with controls. All these cases reveal, in a greater or lesser degree, similar changes. That injections of local anesthetics for dental purposes in almost every case cause the above described changes in the pulp tissue can most probably be stated beyond all doubt.

The explanation of the occurrence of similar changes may be given from a purely mechanical-physiologic point of view. By reason of the injection, an increased intradental venous blood pressure develops. The presence of a collateral circulation would quickly bring about an equalization of the blood pressure. Because of the absence of a collateral circulation, the pressure on the walls of the vessels becomes too great; and a rupture of the capillaries, which are composed of single endothelial channels, will in certain cases take place. Frequently there arises in the vessels of the pulp, on account of previous pathologic processes, a weakening of the walls, which causes a lessening of their elasticity and this circumstance naturally increases the possibilities of rupture.

An increase of the blood pressure does not only bring about an increased possibility of bleeding by diapedesis and by rhexis, but, in the first place, an increased transudation. The blood fluid is pressed through the walls of the vessels in larger quantities than is normal in a purely physiologic condition. The transudation increases and then causes edematous formations in the tissue. In addition, it happens that the "return" resorption of the transudate cannot take place because of the damming up ensuing in the venous part of the vessels. That these edematous formations preferably accumulate along the dentinal wall in the odontoblastema and there lead to the arising of the above described cavities of cystic character must be considered quite natural. The finest ramifications and the largest number of the blood capillaries are situated in and around the odontoblastema. On account of the inherent elasticity of the tissue, the transudate is pressed against the dentinal wall, and hence the principal accumulation of fluid takes place along the dentinal wall.

It seems to me that these microscopic investigations of extracted teeth explain the frequent occurrence of numerous vacuolations, which are situated chiefly in the odontoblastema. Consequently, they are to be ascribed to the occurrence of hyperemic conditions of the pulp either artifically developed, for instance, by injection of local anesthetics, or by the occurrence of pathologic processes in the pulp, the incipient stages of which are hyperemic conditions in the tissue. Westin, Howe and Kotanyi, through experimental investigations concerning the influence of scurvy on the pulps of teeth of guinea pigs, have succeeded in proving similar changes, such as the occurrence of bleeding and cavities in the pulp, of cystic character filled with fluid, the latter being preferably found in the odontoblastema. I refer the reader to the investigations published by Howe, Westin, Kotanyi and others.

From a pathologic experimental point of view, my investigations seem to be of interest in that they may offer for study the possible ability of the odontoblastema to regenerate and its eventual deriva-

tion from preexisting cell elements in the pulp.

SUMMARY

Local injections of procain-epinephrin for dental purposes cause an increased intradental venous blood pressure in the pulp tissue of the tooth. This intradental pressure exceeds the physiologic limit because of the absence of a collateral anastomosis. Within this area of high blood pressure, collection of fluid occurs, which, in the first place, is due to the fact that a further (return) resorption is prevented. These transudative formations frequently occur as edema in the connective tissue, but, above all, the transudate is accumulating along the dentinal wall, in this way forming cavities of cystic character filled with fluid. Owing to this fact, destruction of the odontoblastema takes place.

Immediately after an injection, bleeding by diapedesis and by rhexis occurs as a result of the increased intradental blood pressure. This bleeding is chiefly located in the odontoblastema or its vicinity.

By the reactive arterial hyperemia which is taking place at the time when the effect of the anesthetic has ceased, the development of the pathologic processes in the pulp are very likely increased.

The vacuolation so frequently noticed under the microscope in the odontoblastema in teeth certainly depends on an increased intradental blood pressure caused by hyperemic conditions in the pulp. This hyperemia in the tissue naturally has as exciting causes many different exogenous and endogenous factors.

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PRINCIPLES OF TRAUMATIC OCCLUSION AND THEIR APPLICATION IN THE FIELD OF OPERATIVE DENTISTRY

By JOHN OPPIE McCALL, A.B., D.D.S., F.A.A.P., F.A.C.D., New York City

ABOUT fifteen years ago, the term "traumatic occlusion" was proposed by Stillman to designate a condition which he had identified as being consistently associated with periodontal disease. For a number of years thereafter a lively debate was waged as to the facts with regard to this particular situation. The discussion has virtually ended as far as periodontoclasia is concerned. And it is quite generally accepted today that traumatic occlusion is the predominating factor in the etiology of a large percentage of the cases of suppurative periodontal disorders.

With the acceptance of this doctrine and with the coincidental, although not necessarily related, development of periodontia as a specialty, it might seem that the introduction of this subject into the program of a body of dentists concerned primarily with operative dentistry is ir-

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relevant. I hope to be able to establish the reasonableness of my place on this this program on at least two counts. One of these is that periodontal disease frequently is due to the presence of traumatic occlusion in the mouth, and therefore comes under the observation of the general practitioner or operative dentist before it reaches such proportions that the services of the specialist are required. Under such circumstances, the detection and correction of traumatic occlusion must receive full consideration from the general practitioner. The second count is that traumatic occlusion, according to my observations, is a factor in disease processes other than periodontoclasia which are generally presented to and managed by the specialist in operative dentistry. If this contention is correct, the relationship between operative dentistry and periodontia is close indeed.

May I introduce the subject by describing briefly the effects which traumatic occlusion produces on the periodontal tissues of teeth affected by it. In the first place, traumatic occlusion is nothing more or less than functional occlusion plus. It is simply a normal stress, but a heavier stress than can be borne by the tissues around the tooth without inducing abnormal reactions. Essentially, occlusal stress is a stimulus to these tissues. Without it, the periodontal tissues do not reach their full development. It might therefore seem that an abnormally great stress would result merely in overdevelopment of the periodontium. Occasionally, mouths are seen in which this appears to be the case, but, almost invariably, there will be found, even in these cases, evidences of retrogression. I have in mind here the civilized rather than the primitive races.

This being the case, let us see whether we can trace the retrograde changes and analyze the mechanism by which they are brought about. Box has given to us a study[1] in which he has traced what are probably the earliest tissue changes that can be attributed to traumatic occlusion. His research indicates that the first tissue to be affected is the pericementum, and that the first change in this tissue is a proliferation of the endothelial cells of the blood vessels. The next step is the development of a loosely organized tissue around these blood vessels which replaces, apparently by absorption, the original fibers of the pericementum. Box calls this tissue a fibrosa and the process rarefying pericementitis fibrosa. The next step is the resorption of the alveolar bone adjacent to the fibrosa. As far as direct influence on the tissue is concerned, the traumatic occlusion goes no farther, except by extension of the processes that I have described. In a certain number of cases, for a reason which we do not as yet understand, infection then ensues at the base of the gingival crevice and an inflammation is set up in the marginal and cemental gingiva. Clinical observation leads very strongly to the assumption that this inflammation is directly influenced by the disturbance of the blood vessels in the pericementum, which was induced by the traumatic occlusion. This is evidenced by the fact that the inflammation is frequently sharply localized in a portion of the marginal and cemental gingiva which is directly in line, axially, with the portion of the pericementum which can be demonstrated to be receiving excessive stress.

Another evidence of the relationship of the infection to traumatic occlusion is the localization of the pocket, which begins to form soon after the incidence

1. Box, H. K.: Studies in Periodontal Pathology, Bull. No. 7, Canadian Research Commission, Toronto, 1923.

of the gingival inflammation. Periodontoclasia of the type designated by Box as periodontitis complex, and in which traumatic occlusion is a factor, is characterized by the formation of deep narrow pockets. One who is familiar with the characteristics of traumatic occlusion can almost invariably point out the manner in which excessive stress is being delivered on a given tooth, and can demonstrate its relation to the area on which the pocket is found.

While traumatic occlusion does not produce the infection, a thing which it obviously could not do, it has unquestionably a profound influence on the resistance of the tissues upon which it is acting. This connection is so close, and the sequence of infection following occlusal trauma is so regular, that we are justified in looking on the infection as being virtually the result of traumatic occlusion. The later changes in the pericementum which characterize periodontitis complex are to be regarded as being influenced by traumatic occlusion, through the medium of lowered resistance. I shall not describe these changes, since they lie outside the scope of this paper.

In the course of practice devoted to the treatment of periodontal disease, it naturally follows that a large percentage of the cases will be those showing advanced disease. But it also happens that a certain number of cases of incipient periodontal disease will be encountered. These cases will usually give a definite and apparently satisfactory response to methods of treatment which do not include the adjustment of occlusion. It is both fortunate and unfortunate that this is so. It is fortunate because it has been possible, by such means as may come under the heading of prophylactic treatment, to keep infection in these mouths under control for a long period of time. It is unfortunate, because such success gives a sense of false security to both dentist and patient. And it has been my observation that a large number of cases of advanced disease are those which have been carried along for years with regular prophylactic attention. Retrogression has gone on steadily, although slowly, and the day of reckoning seems inevitable.

On the other hand, cases which I have seen while in their incipient stages, and in which I have been able to detect traumatic occlusion, have invariably been treated with as careful and complete attention to this factor as though they had been in an advanced stage of disease. The rationale of this method of case management is based both on clinical observation and on a study of Box's work. If the first effects of traumatic occlusion are in the pericementum, and if gingival disturbance follows this first lesion, it seems logical to assume that correct treatment for the gingival lesion must be directed toward that agency which is responsible for the pericemental lesion. This is sound treatment for the existing disease and the only way of providing against the progression of the disease with possibly masked symptoms. Practice carried on as indicated has been most satisfactory. Not only do the symptoms rapidly yield to this treatment, but there is also no tendency to recurrence provided the patient takes proper care of his mouth. On the other hand, when occlusion is neglected, symptoms of recurrence rapidly reappear.

One of these manifestations will repay a moment of detailed consideration. Many patients having incipient periodontal disease are troubled with an excessive and rapid formation of salivary calculus rather generally throughout the mouth. It is my observation that this is

directly related to the circulatory disturbance caused by the traumatic occlusion. And when the occlusion is properly adjusted and other appropriate measures have been taken, it has been an invariable experience that excessive calculus formation at once ceases. This at once makes it possible to lengthen the intervals between prophylactic treatments and attests the fundamental improvement made in the health of the mouth.

The significance of these statements need not be dwelt on. If they are correct, it follows that every practitioner interested in operative dentistry will find it to the benefit of his patients to search for possible traumatic occlusion in every case of gingival disease coming under his observation, and to include the relief of this condition in his treatment of the case.

And now I should like to turn to the relationship between traumatic occlusion and lowered resistance, as it applies to the effects which are produced on the dental pulp by traumatic occlusion. The effect of traumatic occlusion is not invariably observed in its major manifestations in the pericementum and adjacent tissues. In a great number of cases, the principal effects of traumatic occlusion are to be observed in the dental pulp. In another rather large percentage of cases, there is to be observed a definite although less easily demonstrated relationship between traumatic occlusion and certain disturbances in the tooth itself. I refer here to the loss of tooth substance at or near the buccal and labial gum line, often called "erosion," and also to certain types of caries.

The influence of traumatic occlusion on the dental pulp may be traced directly in many cases exhibiting clinical indications of pulp disturbance. Before describing these, it may be well to review the mechanism by which they are brought about. Let us recall once more that the first tissue to be affected by excessive stress on a tooth is the pericementum. We have seen that, in many instances, the pericementum and alveolar bone have a susceptibility to this influence, which favors the formation of the fibrosa and the resorption of alveolar bone. But, in many individuals, we find that the periodontal tissues are apparently made of sterner stuff. They do not give way under this excessive strain. The effect which still centers in the circulatory mechanism is then carried toward the apical region. Here, the pericementum is usually somewhat thicker than it is along the side of the root, and the vascular disturbance produces a more profound influence, affecting, quite naturally, the blood vessels entering and leaving the apical foramen or foramina. It requires but little influence of this sort to set in motion a marked derangement of the circulation in the pulp, which may lead in one of several directions. The most severe, but least common, incident is the development of a pulp infection and eventual loss of vitality of this tissue. All of you are familiar with the fact that the pulps of teeth having deep pus pockets become infected and lose their vitality. But the type of case to which I now refer is one in which the periodontal tissues show little or no superficial evidence of disease, and, in particular, exhibit no suppurating pocket. Teeth whose pulps are infected in the manner which I describe, are obviously affected by bacteria floating free in the blood stream, brought to the part more or less accidentally from a source of infection in some other part of the body.

The relationship of traumatic occlusion to pulp disturbance may be established, in the earlier stages, by the relief

which is invariably afforded when occlusal stress is taken away from the affected tooth. When infection has become so thoroughly established that relief cannot be so obtained, the diagnosis is less satisfactory, but it may still be made by the exclusion of other probable factors. Sometimes, these cases present complications which make the diagnosis extremely difficult, as in the following case:

Miss A, aged 18, had been complaining for some time of pain, indistinctly localized, but confined to the upper right maxillary region. There were no pulpless teeth on that side of the mouth, nor were there any symptoms of pericementitis. The third molars had erupted without unusual incident. Her dentist, therefore, made the diagnosis of pulpitis and set about looking for possible caries in several teeth previously filled in the upper right posterior region. Approximoclusal fillings were removed from the first and second bicuspids and first and second molars, and baseplate guttapercha was inserted as a temporary filling. No caries was found, but the pain continued. The roentgenogram disclosed the fact that the pulp in the second bicuspid had receded somewhat from the influence of the previous deep distal cavity. There was an appreciable layer of dentin, apparently noncarious over the pulp. The pericementum at the apex was marked thickened, but the adjacent bone showed no rarefaction. The case was referred to me for diagnosis, a task which was fortunately simplified by the previous exclusion of the usual factors which might have caused the pain. The possibility of pulp infection from the previously filled cavity through the sound, although thin, layer of dentin was of course present. But it was decided to relieve the occlusion with the hope of overcoming the symptoms in that way. It was found that the tooth was striking very hard on its buccal cusp, and this was accordingly ground until it no longer took the imprint of the carbon paper. The patient expressed herself as being conscious of an immediate improvement as regards comfort of the mouth. The symptoms of pain, which she had been suffering for several weeks, promptly subsided, as reported during the next two or three days, and when seen six months later, she said that the tooth had given her no further trouble. It was still vital at that time.

It seems safe to conclude that, in this case, the traumatic occlusion held at least the major position in the etiologic picture.

Very commonly, we find patients complaining of a sensitiveness to heat and cold in teeth which have no caries or very shallow cavities only, and which have little or no abrasion. Here, the exclusion of infection through caries is simple, and the relief which is invariably afforded by relieving the occlusion completes the diagnosis. Occasionally, the effect of traumatic occlusion is not recognized in time, and the pulp loses its vitality. Such cases are apt to show marked periapical disturbance in the roentgenogram, this being taken as evidence that the pulp was actually infected, and that this infection had brought about rarefaction of the periapical bone.

In the absence of definite histopathologic study of pulp in teeth known to have been affected by traumatic occlusion, it is difficult to say at what time infection becomes established in the pulp as a result of the disturbing influence of the occlusal disharmony. The symptoms of which the patient complains in the early stages are usually those of sensitiveness to heat and cold. There is seldom referred pain, as is so commonly found in cases of pulp infection by caries. This hypersensitiveness to thermal change may persist for a long time without increasing or decreasing in severity. Because of the prompt relief which is afforded when the excessive stress is diminished, I have assumed that the condition at that period is an active hyperemia of a mechanical and not of an infective nature. Infection may ensue at any time, this depending on conditions elsewhere in the body, and when it occurs, it is evidenced by referred pain and an in-

creasing severity and duration of this pain. When this stage is reached, the relief of traumatic occlusion does not always bring about a subsidence of the symptoms. It is then evident that the infection has become too firmly intrenched to permit of resolution.

A somewhat rare phenomenon, but one which requires careful consideration in each case presented, is the occurrence of symptoms of tic douloureux in a case having an obvious traumatic occlusion. Stillman has reported a number of such cases, in which complete and lasting improvement has followed the correction of the occlusal disharmony. It is to be noted that these cases seldom present a completely typical picture of tic douloureux. Since the relief of traumatic occlusion has been effective in some of these cases, it would seem proper to attempt relief by the method of grinding before resorting to more drastic measures.

The subject of calcific deposits in the dental pulp has seldom been considered as a possible etiologic factor in traumatic occlusion. To one who will make an extensive study of the roentgen-ray findings in periodontal disease, it will be a matter of considerable interest to note the number of teeth showing calcific pulp deposits which have no relationship to caries, erosion or systemic disturbance. Clinical examination of such teeth will invariably reveal the existence of traumatic occlusion. And in the absence of other reasons which might be advanced to explain the presence of these deposits, it seems logical to attribute them to the disturbance of the pulp circulation induced by traumatic occlusion. Even when caries is present, unless it has penetrated rather deeply toward the pulp, there may be good reason to suspect occlusal stress as the causative agency. This may well cause a modification of the proposed operative procedure to be followed in such cases. In other words, it should be the effort of the operator to attempt to relieve symptoms of pain, or of pulp infection, by attention directed toward the occlusion, before resorting to devitalization. I am satisfied that many pulps showing pulp nodules in the roentgenogram have been sacrificed needlessly because of a failure to understand their possible connection with traumatic occlusion. This does not mean that pulps containing nodules should be conserved when they give evidence of having a well-established infection. This is, of course, because of the poor recuperative ability characteristic of the pulp when once it has become deeply irritated. Yet even this tissue will respond to nature's laws, and will apparently, in common with other tissues of the body, throw off infection if its functional demands are met. It is difficult to diagnose the extent, if not the presence, of a pulp infection. At the same time, the dentist who sees his patients regularly, and who makes a careful and thoroughgoing examination at sufficiently frequent intervals, should be able to detect cases of incipient pulp infection due to disturbed circulation and to treat this condition successfully.

How is the dentist to recognize this condition in its incipiency? He has two guides: pain and the evidence afforded by the roentgenogram. Pain, no matter how slight, is always a significant thing. It is usually the first symptom the patient experiences, and it is never experienced without a reason. Pain may develop in other parts of the body and the conditions which were responsible may pass away spontaneously, but this seldom happens in the mouth, except as the result of some accidental trauma. Pain which

recurs, then, should be the subject of serious study, and the patient should not be dismissed simply because the dentist cannot find a carious cavity. Nor should the patient be dismissed with the intention of awaiting further developments or until the pain becomes so severe that pulp extirpation or extraction is required.

Another group of phenomena having a relationship with traumatic occlusion comprises many so-called erosions and certain types of caries. Every dentist is familiar with the destruction of tooth substance which occurs just above the gingival border on the labial surfaces of the incisors and cuspids, and frequently of the bicuspids as well. Unlike the abrasions produced by injurious dentifrices, these cavities are excessively sensitive to touch. In fact, sensitiveness of the tooth surface is frequently a noticeable and distressing symptom before any actual loss of tooth substance takes place. In these cases, the marginal gingiva usually shows a slight recession, indicating a periodontal disorder. But usually there is little if any sign of redness, although the color of the gingival margin seldom measures up to the exacting standard of perfect health. For many years, I have treated such cases on the basis that traumatic occlusion was the causative factor in the condition. And I have been rewarded with considerable success in alleviating the symptoms of pain by relieving the traumatic occlusion and have also seen an evident checking of the process of erosion. This result in treatment has been so nearly uniform that I have felt no hesitation in asserting that the disturbance was in large part due to traumatic occlusion.

The course of events in such cases is obviously different from that of the types of cases previously mentioned. The theory which I propose is this: There is first a disturbance of the pericemental circulation in a mouth having a fairly high immunity to alveolar disintegration; then, a moderate pulp disturbance following directly on this combination of circumstances, and next the development of a mildly acid exudate from the gingival crevice as the result of a slight gingival infection superinduced by the traumatic occlusion. The net result of these factors is the production of a sensitive spot on the surface of a tooth whose pulp has been rendered susceptible to irritation because of its altered circulation. In such a case, the tooth reacts to the constant production of acid very differently from the tooth whose pulp has a more nearly normal circulation. It will be possible here to read between the lines my belief that the pulp is capable of influencing conditions through the entire tooth, even to the extent of producing a certain amount of resistance to caries.

And now let me introduce another phase of my subject. It has happened on several occasions that I have seen mouths practically free from caries, especially approximal caries, but exhibiting one or two typical Class II cavities. When the mouth as a whole shows an obvious immunity to approximal cavities, yet presents one or two instances of this disease, the reason for such decay becomes a matter of great interest. In the cases so observed, it has been obvious that the teeth so affected were being subjected to excessive occlusal stress, usually with little evidence of susceptibility to periodontal disease. It seems reasonable to suppose that the carious process was inaugurated, as in the case of erosions just mentioned, by the development of an acid fluid in contact with the approximal surfaces, and that this acid was directly related to the traumatic occlusion.

It may be urged at this point that it is fairly typical of periodontal disease that the teeth are not affected by caries. If traumatic occlusion causes periodontal disease, it should not produce caries as well; otherwise, all sufferers from periodontoclasia would have carious teeth. The explanation of this seeming paradox is to be found in the pulp reaction and the consequent influence which it has in protecting the tooth against caries.

It will be seen that traumatic occlusion is to be regarded, not as a specific cause of disease, or the cause of a specific disease, but as a thing which lowers resistance and causes tissue debility. When traumatic occlusion is not relieved, some type of disturbance will surely occur. What type of disorder this will be will depend on the other factors in that particular case. The element of infection; the state of the calcium metabolism of the body; the type of individual as regards neuropathic tendencies; the dietary faults, if any; inheritance; the type of tooth and jaw structure which has been developed during the earlier years of life—the interrelationships of these factors determine the course of the disturbance which will be inaugurated by traumatic occlusion.

If the occurrence of approximal decay, in such cases as those just described, is to be regarded as definitely related to traumatic occlusion, the question may well be asked whether approximal caries, when uniformly distributed through the mouth, is not also to be linked to this disturbing influence. While it might be going beyond the range of present-day observation to state that this is true, often there are indications of traumatic occlusion generally distributed in mouths which are being uniformly attacked by approximal caries. One of the characteristic anatomic forms of teeth notably subject to traumatic occlusion is that of the posterior tooth with long pointed cusps and deep sulci. This formation lends itself particularly to close interlocking of upper and lower teeth. Such teeth are often the prey of generally distributed caries. On the other hand, the tooth with shorter cusps and consequently lessened tendency to interlocking of teeth through cusp interference is less apt to develop approximal caries. It will, of course, be possible to cite many exceptions to this rule, one of these being that the teeth with long pointed cusps do not always suffer from caries, but are frequently sufferers from periodontal disease. This, of course, does not disprove the general theory as to the influence of traumatic occlusion. The type of disturbance which will be produced depends on the other etiologic factors in the case. What we are concerned with is health and disease. The theory which should interest the dentist is not the particular form or symptom of disease which is before him, but the underlying conditions which are responsible for the departure from health. It is so easy to see bacteria and not to visualize broadly the influences which destroy the resistance of the tissues against the bacteria. Traumatic occlusion is a mechanical irritant, and because of the fact that the function of the teeth is so highly mechanical, we should look to mechanical irritants as having a profound influence on the health of the dental mechanism. When we look beyond surface facts, such as bacterial films, erosion cavities and even pulp irritations from caries, we find present, in a large number of apparently dissimilar conditions, the disturbing influence of traumatic occlusion.

DISCUSSION

Leo A. Walzak, Baltimore, Md.: Traumatic occlusion should receive full considera-

tion from the general practitioner, especially in the mouths exhibiting incipient periodontoclasia. Recognition of early signs and symptoms will conclude the detection before much tissue change or destruction has taken place. Dr. Box's "signs of periodontal disease" are of great value in recognizing these incipient cases. Correction of traumatic occlusion at this early stage undoubtedly conserves teeth and the surrounding tissues. Problems of management of advanced cases would be minimized, as there would be fewer such cases. Some opponents of the traumatic occlusion theory fail to recognize the importance of this condition as a factor in these incipient cases, owing to the fact that great tissue change or destruction has not yet taken place. They cannot foresee such an outcome in these cases if the occlusion is not corrected. Dr. McCall brings attention to the improvement in these cases, even though treatment does not include the adjustment of the occlusion. In my experience as a periodontist, covering twelve years, I have noticed that cases which were in my early practice handled according to conservative periodontal routine minus adjustment of occlusion have retrogressed or gone back. The traumatic occlusion in some of these cases has since been adjusted, and they show greater improvement than was possible without the adjustment. If these incipient cases had, in their early history, received consideration from the occlusal standpoint, I am sure that today the mouths generally would show less tissue destruction and more intact teeth. Accepting Dr. Box's statements regarding rarefying pericementitis fibrosa, although they have been challenged, I should like to ask Dr. McCall what happens to this fibrosa or new tissue after proper treatment of the case. I know that Dr. Box regards traumatic occlusion as the initial factor in the production of the fibrosa. What happens to the fibrosa when the trauma is corrected? Pulp conditions; hypersensitiveness of cervical areas of teeth; erosion; certain types of caries and obscure dental pains, etc., Dr. McCall associates at times and to some degree with traumatic occlusion. This is most interesting to the general practitioner and bears investigation on his part. The effect of supraclusion on the pulp in the case of a high filling or inlay is unquestioned. Therefore, is it reasonable to expect that pulpal disturbance could be traced to traumatic occlusion, whether the stress is excessive centric, lateral or protrusive, or combined? Let us consider the group of so-called erosions and certain types of caries in which destruction of tooth structure is evident just above the gingival border on the labial surfaces of the incisors and cuspids and frequently of the bicuspids, which Dr. McCall believes are caused principally by traumatic occlusion and pulp influence. Dr. McCall's belief that the pulp is capable of influencing conditions throughout the entire tooth, even to the extent of producing a certain amount of resistance to caries, is reasonable when we consider the functions of the pulp. To determine the relation of traumatic occlusion and the pulp to these cases of erosion and labiocervical caries, would pulp devitalization according to the following procedure be of value? 1. Remove the pulps from several teeth in the upper jaw and likewise in the lower jaw and correct the occlusion. Observe over a period of time whether there is any difference in the rate of destruction in the pulpless teeth as against the vital teeth. 2. The only difference from the suggestions in 1 would be not to correct the occlusion. Check tooth against tooth, and case against case, both from the trauma angle and the pulp influence separately and from the combined influences of both. It would be difficult to select similar cases as I know the various other factors might differ. This is merely a suggestion. Please understand that I am not advocating promiscuous pulp devitalization. Years ago, in treatment of cases of periodontoclasia, pulp devitalization was practiced with the belief that the blood supply and resistance of the tissues would be increased and the periodontoclasia would be improved. This practice is now obsolete. Dr. McCall's point in attaching importance to the slightest indication of pain, and advising thorough investigation, is worthy of much thought with reference to traumatic occlusion as a possible factor. Remote, obscure, transient pains are too often carelessly dismissed if no caries or roentgenographic evidence exists. After all, the effects of traumatic occlusion are localized in the tissues immediately adjacent to the teeth, but the degree of disturbance or destruction varies according to the resistance or type of these tissues. Dr. McCall notes these general factors thus: "the element of infection; the state of calcium metabolism of the body; the type of the individual as regards neuropathic tendencies; the dietary faults, if any; inheritance; the type

of tooth and jaw structure which has been developed during the earlier years of life; etc." These general factors influence the state or type of the local tissues. Therefore, if we deal with local tissues of a certain type or of low resistance, the effects of traumatic occlusion may progress rapidly; whereas, in the high resistance types, symptoms may be obscure or lacking and the progress or rate of destruction be less rapid. If we encounter such a case, a false opinion may be formed regarding traumatic occlusion as being of little or no importance in the mouth generally. I appreciate the complexity and variety of factors to be considered in classifying a case in regard to type, and coming to an intelligent conclusion as to the application of the various theories in regard to each case and problem. It is true that the mouth is a mechanism. Traumatic occlusion or the factors which produce it, if present, sooner or later disrupt this mechanism. This can be proved to anyone who honestly and intelligently takes the time and trouble to investigate.

A. W. Bryan, Iowa City, Iowa: Dr. McCall's paper without doubt justified its appearance on the program of this section. A definite relation does exist between abnormal occlusal stress and operative procedure. On the first count used by Dr. McCall to justify his paper, he states that traumatic occlusion comes under the observation of the general practitioner before it reaches the specialist. It is my belief that the responsibility goes much further than that. Many cases of traumatic occlusion can be traced directly to operative work which has been performed some time before. A patient complains of sensitive areas in the bicuspid and molar region, and examination reveals exposed cementum, with the accompanying destruction of the marginal and cemental gingiva. Large proximoclusal restorations have been made in the involved teeth several years before. The patient asserts that, previous to that time, the gingiva covered these areas. The restorations are decidedly deficient in occlusal contour, and the cause of the destruction of the supporting tissues is easily seen. The occlusal contacts have not been adjusted correctly and an excessive stress, in the wrong direction, has been delivered to the tissues. These are not rare cases and, to my mind, they indicate a tremendous responsibility to the general practitioner. It is well that Dr. McCall has emphasized the point that traumatic occlusion is nothing more nor less than functional occlusion plus, and in the wrong direction. It has been interesting to hear and read, in papers by those who do not believe in traumatic occlusion, that teeth were built to stand stress, and therefore stress should not cause destruction of the supporting tissues. But the fact remains that stress directed in the wrong direction causes changes in those tissues receiving it, because they were not built to stand it. Emphasis should be placed on the statement concerning the difference in tissue change in two individuals. All individuals do not respond alike to the same stimulant. A force which is a stimulant to one is an irritant to another, and we therefore see different tissue reactions. One of the most important relationships between traumatic occlusion and operative procedure mentioned by Dr. McCall is that of the effect of traumatic occlusion on the pulp. This applies not only to the immediate effect of hyperemia and discomfort, but also to the eventual result of chronic tissue changes and infection. Dr. McCall has opened a broad field in his observations on the relationship between approximal caries and traumatic occlusion. In the past, we have been led to believe that the soft tissues which normally extend entirely to the contact point protect the tooth surface just gingivally from the contact point from plaque deposits. If, through excessive stress, destruction of the septal bone structure occurs, there follows the recession of the gingiva, and the tooth surface becomes subject to plaque deposit. These observations of Dr. McCall are important, and further study to determine the change in acidity of the tissues of the marginal gingiva should be made. It is to be hoped that his paper will stimulate the interest of the operative dentist in a closer study of the relationship between occlusion and the health of the supporting tissues.

Dr. McCall (closing): "What happens to the fibrosa which is produced in case of the periodontoclasia after treatment has been given, assuming, of course, that in this treatment traumatic occlusion is relieved?" That is a question that I cannot answer specifically in terms of finished cases. The normal relationship of the gingival border to the base of the gingival crevice, will measure in the average case about 2 mm. The pericementum will be continued up to the base of the gingival crevice. The bone does not come up so high. When the tooth is acted on by traumatic

occlusion, formation of the fibrosa results in resorption of the bone facing the tooth. After a short time, infection sets in at the base of the gingival crevice and a pocket is formed. The tissue which immediately surrounds the pocket is in a state of inflammation. This represents a very early stage of disease, and if we treat the case at this time, we can assume that the fibrosa no longer is advancing. There are some cases in which in the roentgenogram we see that the bone closes up around the tooth, where before there was a thickened pericementum indicating a fibrosa. What happens to the fibrosa itself, we can only guess. I believe that the pericemental tissue may be rebuilt in its original form. I believe that new bone will form to replace partly that which has been absorbed, but we have no direct information on that point. When we have an advanced case, with the pocket extending well down on the tooth, the bone has been absorbed continuously before the advancing pocket, and the fibrosa is always below the base of the pocket. I have not been particularly interested in what happened to the fibrosa in the advanced case because my attention has been largely on the pocket. In these cases, I have often been able to see evidence of a marked regeneration of bone following the treatment of the case. That occurs only where there has been a closing up of the pocket by reattachment of the tissues. This is a point which leads us a little way from the main subject of my paper, but I should like to make that point clear for the information of those who wish it. We have found that attachment of the tissue which remains takes place in a large number of cases which are properly handled, and in a certain percentage of those cases, the roentgenogram will show that the bone has grown part way up the tooth. Some of these cases are striking and some show little or no change in the position of the bone. When we have bone formed, what is evidently new bone, I am sure that the fibrosa also is largely absorbed and replaced by a tissue which more nearly resembles the original pericementum. We have found in one case, which was sectioned after reattachment had taken place, and had persisted for a number of years, that there was a formation of new tissue at the site of the pocket and this did not resemble the pericemental tissue, nor did it have the characteristics of the fibrosa. Taking up the suggestion of Dr. Walzak, regarding devitalizing: I have not gone into the subject of devitalizing teeth. I believe there, too, that the influence of occlusion is something to be reckoned with; but instead of taking two different mouths and relieving the traumatic occlusion in one and not the other, I should complete the work in the one mouth. Of course, this is an academic discussion, but some such experiment might sometime be performed by one who has an opportunity for animal experimentation, and it is a suggestion which I think we should keep in mind.

THE USE OF THE ROENTGEN RAY IN ORTHODONTIA*

By FRANK M. CASTO, M.D., D.D.S., Cleveland, Ohio

IT is not my purpose in this brief paper to discuss apparatus, technic or special methods for making roentgenograms, its primary object being an appeal to the orthodontist or those interested in orthodontic procedure to make a more general use of the roentgen ray.

I am strongly inclined to the belief that a large percentage of orthodontists, as well as the general practitioners who are interested in orthodontia, are not using the roentgen ray to the best advan-

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tage in the diagnosis, care or treatment of their cases. It is probably true that only a comparatively few men are making a complete roentgenographic survey as a regular routine at the beginning of treatment or for use in making a diagnosis. To overlook or neglect this part of the work is unquestionably a grave mistake and may lead in some cases to serious complications and embarrassment. The value of the roentgenogram previous to, during and after treatment has been so thoroughly demonstrated that one cannot understand why so many fail to use it.

It is not my intention to discuss the question in regard to the advantages or disadvantages of the orthodontist having the roentgen-ray work done in his own office or of referring the patients to a roentgenologist for such service. Undoubtedly, sound arguments and valid claims can be presented by both sides. It matters not where the service is rendered, but it does matter as to whether it is rendered. It depends largely, I presume, on the personal equation of the individual and the facilities with which he has to work. I have tried both plans, but prefer to have the service rendered in my own office.

The importance of using a good technic, of making proper exposures, of taking pictures at various angles when deemed necessary, of using an efficient apparatus, of taking care in developing and making a careful and intelligent interpretation is perfectly obvious. In many cases, the interpretation of roentgenograms presents problems, the complexity of which make them difficult to solve. The correct solution is dependent largely on the character of the pictures and the knowledge and ability of the operator. A thorough understanding and familiarity with the anatomic and histologic structures concerned and their normal variation plus experience are necessary qualifications. Because of the many anatomic variations and the frequently occurring anomalous conditions encountered, one should be most careful in making deductions and arriving at definite conclusions; yet the importance and necessity for making these determinations cannot be overestimated.

Several years ago, when the roentgen ray had developed to a point of practical usefulness, I recognized its importance in the practice of orthodontia and adopted the policy of making full mouth roentgenographic surveys in every case before treatment was begun. Fortunately, I have adhered rigidly to this plan ever since, and it has not only supplied me with much necessary information, but also, in many cases, has prevented considerable embarrassment. I recall quite vividly at least one such case which exerted considerable influence in leading me to adopt this plan.

The patient was a splendid physical specimen, with teeth of the same quality and of beautiful design. The case was a mixed denture in class 1. The left maxillary teeth, from the deciduous cuspid back and including the first permanent molar, were in lingual occlusion with minor malocclusal relations of the maxillary and mandibular incisors. Correct occlusal relationships were restored without difficulty. The deciduous teeth were succeeded by the permanent ones in good order, except three of the deciduous second molars, two maxillary and one mandibular. The case represented what I considered to be so nearly a normal condition that I had not the least apprehension that there were any missing teeth. I had no roentgenograms of the case. Imagine my chagrin and embarrassment when the parents returned from the of-

fice of an exodontist to whom I had referred the case, with the information that the three deciduous molars were missing.

Another case of as much and perhaps even more interest was one in which the maxillary lateral incisors had been moved a considerable distance. This was also a case in class 1. The patient was 13 years of age. All of the permanent teeth, including the second molars, had erupted. The arches were expanded and several of the teeth rotated and all were placed in good occlusal relationship, the result being most satisfactory to me. No roentgenogram had been made. As a matter of fact, it was before the roentgen ray had come into very general use. The patient returned in about eight years and complained that the maxillary lateral incisors were quite loose and sensitive and that they annoyed her considerably. On examination, I found her complaint well founded. The lateral incisors were loose, quite loose, and sensitive. The tissue around the teeth was considerably irritated and all indications pointed to the fact that the roots were wholly or in large part missing. Roentgenograms told the sad story. Of course, I do not know, although I have my suspicions, whether the roots of the teeth had been absorbed because of orthodontic interference or whether they had never developed. The roots of the other teeth had not been affected in any way. For your information, I might say that artificial substitutes were supplied for the lost lateral incisors.

We follow the method generally of using extra-oral plates for the posterior teeth, bite films for the incisors and intra-oral films in the cuspid regions. This method in our hands has many advantages over that of using a large number of intra-oral films. In the first place, the pictures can be made with less difficulty, with much less inconvenience and annoyance to both the patient and the operator and consume only about one-third as much time. The plates indicate better the relationship between the teeth and between the teeth and the contiguous tissues. They also disclose more clearly anomalies and the fact that teeth are missing, and when taken with the teeth in occlusion, record the mesiodistal relationship. In any case, if it is desired to get more detail in a localized area, the use of additional films is advisable. The Raper bite-wing method is used for the detection of cavities in the teeth when considered necessary.

Roentgen-ray profiles of the patient and stereoscopic views have been used in special cases with good results. They have in the first instance indicated the relationship between the hard and soft tissues and, in the second, have given a better perspective and assisted in determining the relationship and localization of the different parts concerned. The use of the stereoscopic views is strongly recommended in certain cases and is really indispensable in arriving at a definite diagnosis in such cases. I have not adopted these methods as regular routine, using them only when it is deemed expedient, but to those who are interested in obtaining the best results by the use of the roentgen ray, I should at least advise that they familiarize themselves with the methods for making these pictures. It is quite certain that they will prove useful.

As I intend only to emphasize the use of the roentgen ray in the practice of orthodontics, and since there is an abundance of material already written and published by men of broad experience, and who have made exhaustive investigations in this field, it would seem quite unnecessary for me to discuss at length the many indications for its use. Therefore, I shall

call your attention only to the more outstanding ones.

In addition to the roentgenographic survey at the beginning of treatment, roentgenograms should be made at such intervals as the requirements of the cases may indicate during the progress of treatment. They should be used after active treatment, while the case is still under observation, and until all of the permanent teeth are accounted for, particularly the third molars. The length of intervals at which roentgenograms should be made cannot be stated. This will vary in individual cases and will depend both on existing conditions and the judgment of the operator.

In my opinion, it is quite important, in fact quite necessary, to be in possession of the following information at the beginning of the treatment of every case, and such information is only available through disclosures made by the use of the roentgen ray: (1) anatomic variations, if any; (2) character and condition of the bone; (3) presence or absence of anomalous growths, tumors, cysts, etc.; (4) presence of anomalous or supernumerary teeth; (5) presence of the unerupted permanent teeth and the relationship and position of their crowns; (6) stage of development of the permanent teeth; (7) stage of resorption of the roots of the deciduous teeth; (8) presence of impacted teeth, with localization and study of the adjacent tissues; (9) condition of the roots and adjacent tissues of pulpless teeth; (10) condition of the septums and contiguous parts; (11) presence of cavities in the crowns of the teeth which are otherwise unobservable.

The following are indications for the use of roentgenograms during treatment:

1. To observe the condition and stage of resorption of the roots of the deciduous teeth, especially when their removal is indicated. (I do not believe that any deciduous teeth should be removed, when it is necessary to enlist the services of an exodontist, without first having the relationship of the crown of the succeeding permanent tooth to the roots of the deciduous tooth revealed by the roentgenogram.)

2. To study the condition and relationship of the roots of the teeth that are being moved.

3. To observe and study the change in the character of the bone during tooth movement.

4. To study the condition of the tissues contiguous to impacted teeth.

5. To observe the effect, if any, on unerupted teeth of the distal movement of molars.

I have seen a number of cases in which the distal movement of the mandibular first molars caused impaction of the second molars. It is almost certain that the distal movement of mandibular second molars will either cause or exaggerate the impaction of the third molars. The roentgenogram may also be used to observe the fit of orthodontic bands and to indicate whether there is encroachment on the soft tissues.

6. To study the effect, if any, on the septums and investing tissue during tooth movement.

7. To study any pathologic condition that may occur.

8. In case of an accident, to determine the extent of fracture, if any.

9. When a tooth is broken, particularly an anterior tooth, to determine the proximity of the fracture to the pulp chamber.

10. To observe the progressive development of unerupted teeth.

11. To be used as an adjunct in the examination of the teeth for cavities.

After the active treatment has been completed and the case is under observation, the roentgenogram will be useful for many purposes:

1. In a mixed denture, where the resorption of the roots of the deciduous teeth has been delayed or they are resorbing unevenly, to determine the time for the removal of such teeth.

2. To observe, during the transitional period of permanent occlusal adjustment, the relation of the roots of teeth that have been moved.

3. To study and record the condition of the roots of teeth that have been partially resorbed during tooth movement.

4. To observe and record the stages of development of the third molars, and when they are directed toward impactions, to assist in determining the correct procedure in treatment.

I have not attempted to enumerate all of the uses for the roentgen ray in the practice of orthodontia, but having all of these facts before us, it seems to me inconceivable that any person should neglect to use such a valuable adjunct in orthodontic practice. If the science of orthodontia is to progress as rapidly in the next decade as it has in the last decade, it behooves us to employ every means available for making diagnosis and for the proper care and correct treatment of our cases. It is only by such practice that the intricate and complex problems with which we are confronted can be solved and the present status of orthodontia be maintained.

There are a number of men to whom much credit should be given by the orthodontists for the excellence of their work in developing the practical use of the roentgen ray, for the scientific investigation they have consistently and persistently carried on and for the many valuable contributions they have made. Among those who may be prominently mentioned are Kells, Simpson, Raper, McCoy, Ketcham and Young.

If what I have said will encourage the more general use of the roentgen ray by any orthodontists or those interested in orthodontia, the object of this paper will have been fulfilled.

TUFTS AND LAMELLAE IN THEIR RELATION TO POSTERUPTIVE FORM CHANGES IN THE ENAMEL*

By THEODORE B. BEUST, D.D.S., Louisville, Ky.

CAN an erupted, enamel-encased tooth crown change in its dimensions as a result of physiologic growth? A reply to this question, based on the premises of dental embryology, must deny such a possibility. Despite all logical deductions, observations pointing to the occurrence of posteruptive tooth growth have been recorded.

At the last meeting of the International Association for Dental Research[1] H. H. Donaldson, reporting on his observations on rats,[2] noted variations in the measurements taken of young and old groups of these animals, the molars of the older group exceeding in size those of the younger by about 10 per cent. This figure applies to both the anteroposterior length of the tooth rows and the transverse diameters of the teeth individually. This report, which assumes a posteruptive growth, supported a conclusion at which I had arrived several years ago while studying the jaws of the pig. During an investigation in which sixty mandibles[3] were used for comparison, measurements were undertaken. It was noted at that time that the diameters of the teeth of the older animals were greater than those exhibited by the younger.[4]

Today, the results of measurements of three categories of lower teeth, in which all of the measurable mandibles in my possession were included, will be presented. As the values of each tooth were taken, they were recorded on a graph. (Fig. 1.) The graph shows, in the lower row, the diameters of the hindmost deciduous molars; the middle row shows the measurements ascertained for the first permanent molar, and the upper row, those for the second permanent molar.

At the beginning of the study, the dried specimens were segregated into four groups. One group contains animals of known age. These are collectively labeled on the graph as the "Young Group." The age in this division ranges from 5 weeks to 4½ months. In the second group, in which the age of the animals can only be conjectured by the state of development of their dentition, were placed the mandibles in which only the first of the permanent molars had reached the occlusal plane. This tooth erupts, as nearly as can be ascertained, at about the

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*Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 9, 1929.

1. Donaldson, H. H.: Abstr. J. Dent. Res., 9: 285 (March) 1929.

2. Donaldson, H. H., and French, H. E.: Anat. Rec., 34: 277 (Feb.) 1927.

3. Beust, T. B.: J. Dent. Res., 8:99 (Jan.) 1928.

4. Beust, T. B.: Disc. J. Dent. Res., 9:286 (March) 1929.

fifth month. The jaws of the third group exhibit two permanent molars, the second in this group having been added to the first. The second molar is said to erupt shortly after the tenth month. The fourth and last group represents mandibles with the three permanent molars erupted. The third molar is estimated to erupt at about the eighteenth month.

The second and third groups are composed of high class marketable slaughter house stock, the animals in this group ranging from 130 to 250 pounds. (Fig. 2.) The fourth group contains the animals usually sold as roughs. These may be of relatively low weight or weigh as high as 800 pounds. As the specimens, except those of the first group, were procured from slaughtering establishments, the mandibles measured were presumably derived from animals in good physical condition. The largest males of their respective litters were selected for the first group and were slaughtered under my supervision. The youngest, in which the first permanent molar was not yet erupted, was not yet 5 weeks old. (Fig. 3.)

In age, the first three groups merge imperceptibly into one another. There cannot be over one year's difference between the youngest of the first and the oldest of the third group, and the difference between the oldest of the second and the youngest of the third group may be only a matter of two or three weeks. On the other hand, the differences between the members of the first and fourth groups are considerable and logically exhibit the greatest variations of the curve.

The measurements were taken with a Boley gage, the jaws of which were allowed to rest on the enamel immediately over the amelocemental junction. In each instance the transverse diameter of the tooth was determined. Where through absence of the tooth or through a loss which was due to abrasion or to mutilation, a value could not be determined, zero was recorded on the graph.

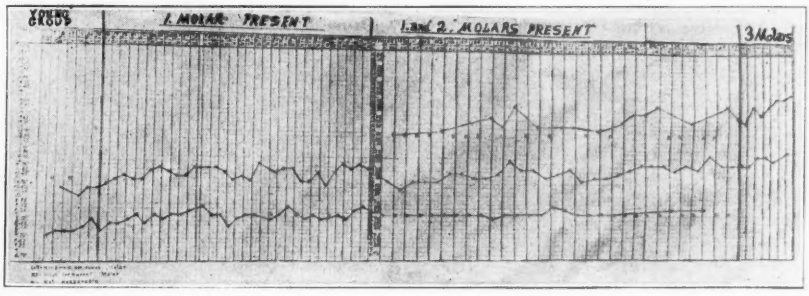

Fig. 1.—Curve of the seventy-seven mandibles registered.

In some of the jaws, the amelocemental junction of newly erupting teeth was still beneath the margin of the bone. In such cases, a small portion of the bone, amounting possibly to 2 or 3 mm., was removed in order to allow the insertion of the measuring instrument. It may be objected that the deposition of enamel may have been in progress in such instances. Any deficiency in size accruing through such a procedure would be more than compensated for by the losses exhibited by the mature teeth through attrition.

Losses from this source are profound. Some of the specimens rejected on this account as being unfit for registration would unquestionably have exceeded the maximum figures indicated on the graph by a wide margin. The graph therefore indicated the minimum amount of change occurring.

The divisions shown on the graph represent fourths of millimeters. With the aid of a hand lens, such readings are easily determined on the measuring instrument. The material in my possession indicates, as can be seen by averaging the values, that posteruptive growth occurs in the tooth crowns of the pig.

Fig. 2.—Mandible of pig with two permanent molars erupted. The hindmost deciduous molar is about to be replaced by the succedaneous tooth visible in the illustration *(a)*.

The average measurements for the hindmost deciduous molar, which is a very narrow tooth, are as follows[5]: First group, 8.125 mm.; second group, 8.81 mm.; third group, 9.05 mm.

The averages for the first molar are: first group, 10.12 mm.; second group, 11.41 mm.; third group, 11.55 mm.; fourth group, 12.33 mm.

The averages for the second molar are: third group, 14.46 mm.; fourth group, 15.53 mm.

It may be emphasized that a difference amounting to a millimeter in diameter is distinctly appreciable to the eye. When it amounts to over 2 mm., as is shown to occur in the case of the first molar, the variation is evident indeed.

Although seventy-seven mandibles are here represented, the small number recorded in the first and fourth groups would not have justified, in my opinion, such revolutionary conclusions; but the contention has been published that the crowns of erupted teeth grow in diameter, and we should not adopt, as has heretofore been done by two prominent investigators of the enamel vitality question, the old-fashioned mode of disposing of antagonizing conceptions by failing to give due consideration to the observations or experiments of others.

In studies of this kind, it is important that normal (in the case of the pig, marketable) specimens be used. The presence of pigmies or giants, which occur in all classes of animals, or the physical quality of the food, may influence the figures obtained. Our knowledge of the influence of function on structure would

5. This tooth is not represented in the fourth group as it is normally replaced before the third molar appears. (Compare Fig. 2.)

lead to the inference that corn-fed pigs, when dried grains are masticated by the animal, would exhibit greater gains than slop-fed pigs. Other influences may, as our experience in this line of work broadens, become evident.

If the conclusion has been reached by some that posteruptive growth of tooth crowns occurs, it behooves us to inquire into the mechanism of such growth. To me, the real difficulty in the solution of this problem lies not in the explanation of the changes incurred in the enamel tissue but in what occurs in the dentin. Apparently, Nagaeli's ideas of intussusception will explain the growth phenomenon in the case of the dentin. For adult enamel, such processes are more difficult to conceive. In this tissue, we must probably look to the tufts and lamellae for an explanation.

For many years, von Ebner, Caush, the Bödeckers, Percy R. Howe, Mummery, Bunting, Fish and I contended that circulatory movements occur in the enamel.

In 1912 and subsequently,[6] I demonstrated, by causing stains to permeate the enamel by way of the dentinal tubules, that fluids could enter certain channels in the enamel of extracted teeth and also that the permeability of the enamel varies according to the age of the subject from which the tooth is derived. This observation justified the view that the channels or capillary spaces in the calcified tissue become filled with some impermeable substance, a view also shared by Bödecker. Such anabolic changes must unhesitatingly be pronounced growth phenomena. Now, we are called on to make a distinction between changes in consistence and changes in volume.

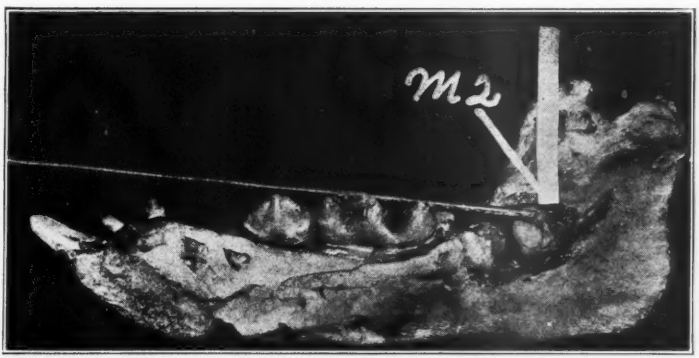

Fig. 3.—Mandible of pig with two deciduous molars erupted. The wall of the crypt of the first permanent molar has been removed. Immediately below the end of the strip of paper was found the germ of the second molar, which, at this age, was the size of a radish seed (estimated age approximately 4½ weeks).

To appreciate the rôle of the tufts and lamellae in changes in volume, it is imperative that the anatomic arrangement of the rows of tufts which pervade the

6. Beust, T. B.: Dent. Cosmos, 54:659 (June) 1912; 56:185 (Feb.) 1914; Physiologic Changes in Structure of Enamel, J.A.D.A., 11:398 (May) 1924; Capillaries of the Enamel and Their Relations to Mottled Teeth, ibid., 13:980 (July) 1926.

enamel be understood. In 1925,[7] enlarging on earlier observations, I described the tuft rows that are so conspicuous in the enamel of man. These structures are found in the enamel of all of a number of animals examined for them. Histologists have not yet recognized the effect of this tuft distribution on the texture and physical behavior of the enamel. No description of the enamel is correct which disregards these parallel rows of spaces which divide the inner portions of the enamel into parallel compartments. (Compare Figs. 4 and 6.)

Orban[8] partly corroborated my findings as far as the origin of the tuft "fibers" are concerned, but failed to confirm their gross anatomic arrangement as laid down in my investigation. Each tuft, thousands on thousands of which enter into the formation of the partitions dividing the inner enamel tissue, represents a circulatory unit. Orban correctly recognized the linear origin of the tuft "fibers," but regards them as developmental defects, a view in which I cannot concur. The lamellae, which have been so ably described by Bödecker, must originate through microscopic dilatation along the lines of the tuft rows. Both the tufts and lamellae, at their points of origin, follow the long axis of the tooth. As regards this uniformity in distribution, many lamellae (or shall we say tufts?) lie in the borderland between the two. Tufts, which often reach the periphery of the rods, may, with equal right, be called lamellae.

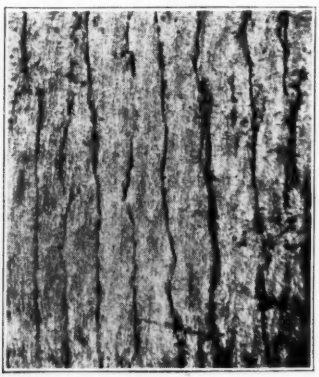

Fig. 4.—Under surface of human enamel showing parallel markings caused by the entrance of the tuft rows.

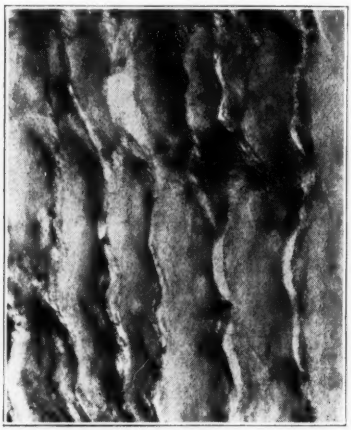

Fig. 5.—Inner surface of a cow's central incisor showing cleavage along the parallel rows.

Orban assumes that lamellae originate, in part, through tears in the enamel tissue which occur during the intrafollicular development of the tooth into which the surrounding tissues grow. This view, which is shared by Gottlieb, appears to account for a certain class of lamellae; but Orban describes another kind of lamella as being formed by poorly calci-

7. Footnote 6, third reference.

8. Orban, Balint: Fortschr. d. Zahnheilk., 3:749 (Sept.) 1927; Dental Histology and Embryology, Ed. 2, Philadelphia: P. Blakiston's Son and Co., 1929.

fied tissue. This second variety is, I believe, the common lamella—the lamella which is being considered in this paper. I disagree with the opinion, however, that these structures are composed of hypoplastic tissue. Their 100 per cent occurrence in 100 per cent of normal teeth justifies the view that they are normal anatomic structures. My experience in viewing specimens indicates that such lamellae may be formed by a dilatation of the lumen of the circulatory channels (i. e., the tufts), any time throughout the life of the tooth pulp. Tension, incident to growth changes, constitutes the dynamic element. The force may also affect the interprismatic region removed from the tufts and lamellae. Concomitant with this dilatation, the circulatory fluid, formerly styled by me plasma, but now more appropriately called "dental lymph" by Bödecker,[9] permeates the tissue. A calcification or keratinization of the matrix provided by the lymph completes the process. Decalcification experiments teach us that the substance sclerotized in the capillary spaces between the rods is more resistant to weak acids than the enamel rod substance itself.

Fig. 6.—A 16-mm. view of the inner surface of human enamel. The parallel markings correspond to the entrance of the tufts (hila).

Recognition of the changes indicated would suggest the mechanism by which enamel-encased tooth crowns can change in form after eruption.

9. Bödecker, C. F.: Dent. Cosmos, 71:586 (June) 1929; Textbook of Dental Histology, New York: The Macmillan Company.

INDICATIONS FOR FIXED BRIDGEWORK*

By LEE WALTER DOXTATER, D.D.S., New York City

THE title of this paper, "Indications for Fixed Bridgework," is in itself an indication that I regard fixed bridgework as having a definite and important place in dental restorations. Sufficient time has elapsed since the introduction of removable bridgework to permit an evaluation of this type of restoration, as to its place in dentistry. And since it also happens that during this same period the methods of constructing fixed bridges have advanced very materially, it is possible to make a com-

*Read before the Section on Partial Denture Prosthesis at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 10, 1929.

parison between the two types and to decide where each kind of bridgework may be used with the greatest success.

There are two reasons why fixed bridgework has a place in dentistry. The first and most important is that it will best serve the health and comfort of the patient in properly selected cases. The second reason, which is directly related to the first, is that, in a certain number of cases, removable bridgework is detrimental to the oral health of the patient.

Another point which may often be properly considered in making a decision is the preference of the patient, which, for psychologic reasons, is practically always for fixed bridgework. This involves the feeling of the patient that the removable piece is more definitely false than the fixed one. Also, most removable bridges have sufficient movement to give a slight feeling of insecurity, which may cause much mental disturbance to certain types of patients. Other things being equal, the patient will nearly always be better satisfied with a fixed bridge than with a removable one.

The dentist should, of course, never be swayed in his judgment by the preference of the patient. Nevertheless, with the methods now available, it is often possible to construct a fixed bridge in cases in which fixed bridgework in the past has done much harm, and in which, at the present time, there might be a well balanced choice between the fixed and removable type of restoration.

The subject may best be approached by considering the features of early fixed bridgework which brought it into disrepute. The first thing which aroused concern on the part of the dental profession was the tendency on the part of many operators to place fixed bridges having spans of such length that the abutment teeth could not carry the load. Such bridges obviously brought about weakening of the abutment teeth through periodontal disease. The remedy was obvious, but it was not always a simple matter to say how long a span of bridgework certain teeth could safely carry. This leads directly to the second point, which is that frequently even short bridges have caused periodontal disease in the abutment teeth even though the load was evidently within physiologic bounds. This point will be discussed presently.

The most serious condemnation of fixed bridgework came from its apparent effect in bringing about focal infection. This issue was for a time seriously confused through the condemnation of fixed bridgework by Hunter. His theory was that because of the difficulty in cleaning the bridge abutments and the spaces under the pontics, infection inevitably became established. While such conditions may develop in improperly constructed cases, it has been found that infection from this source is far from inevitable. Careful analysis of focal infection cases has shown that a large proportion of the infection found has been due to the destruction of pulps under improperly planned bridges, or to periapical disease caused by imperfect pulp canal technic in pulpless abutment teeth. Needless to say, the proper planning and execution of bridge cases makes it possible to avoid this complication, a thing which may occur in removable as well as fixed cases.

Another source of difficulty in the older fixed bridgework was the gold shell crown or other banded crowns. Caries frequently occurred on crowned abutments; also, the crown bands were frequently a source of gingival irritation and periodontal disease. Crown bands were too often improperly fitted, and

even when they did not cause irritation of the gingiva, would serve as catchalls for food particles, mucinous accumulations and bacterial growth. Such unsanitary conditions were, of course, to be condemned.

The first requisite in successful fixed bridgework is the consideration of the occlusion. Stillman and McCall have shown conclusively the effect of traumatic occlusion in bringing about periodontal disease in single teeth. From this starting point, they have developed quite logically the thesis that traumatic occlusion will do still more harm to teeth which are carrying the added burden of bridgework, either fixed or removable. It is not too much to say that their contributions have made possible successful bridgework; for without a knowledge of the relationship of occlusal stress to periodontal health, the dental profession would still be floundering in a state of uncertainty as to the failure of a large percentage of bridges. Given the proper adjustment of occlusion in the mouth and correct planning from the engineering standpoint, fixed bridgework may be constructed, where indicated, with full expectation of success. The demands imposed by the requisite occlusal equilibration are such that the making of a successful fixed bridge may be impossible without considerable reorganization of the mouth. This often introduces a complication into the making of even a short fixed bridge. The fundamental principle cannot safely be violated for the sake of expediency. It should also be stated that this same principle must be applied in the construction of removable bridges.

Another point of great importance in bridgework is that it shall not jeopardize the health of the pulp. No attachment should be used which will favor or render easy the initiation of caries, especially in a location where its detection will be difficult. No attachment should be used which will require such deep cutting into the tooth that pulp death is likely to ensue. This is an accident which has unfortunately followed the preparation of teeth to accommodate internal attachments for removable bridges, and of course no attachment should be used which by its nature calls for the previous devitalization of the tooth. With the introduction of the casting process, the necessity for using the gold shell crown and the dowel crown virtually disappeared. The three-quarter crown, the modern approximoclusal inlay and the pin ledge attachment have made possible fixed bridgework without pulp destruction from either caries or direct traumatic shock.

Sanitation takes its place along with the other requisites which have been mentioned in connection with fixed bridgework. The recent advances in the manufacture of various types of pontics have made it possible to construct not only cleanable bridges, but also bridges having pontics which make contact with the mucosa of the ridge, which are not only cleanable, but also cause no irritation of the mucous membrane against which they rest. A requirement for the pontic which is to rest against the mucosa is that it shall be of highly glazed porcelain wherever such contact is made. These modern pontics make this possible and also provide for the satisfactory restoration of anatomic form, including the development of correct interproximal spaces, thus approaching in effect the influence of the normal tooth structure.

Having brought out the basic requirements for fixed bridgework, and having indicated the possibility of successfully meeting the requirements of health and

comfort with this type of bridge, it remains for me to discuss the various types of cases in which fixed bridgework may properly be used. As already pointed out, the load which the abutment teeth must carry is given first consideration. With abutment teeth having good alveolar support, any missing single tooth may be properly replaced by a fixed bridge. In a great many instances, a span of two may safely be carried. But in the posterior region, it is seldom wise to call on two teeth to carry a span of three pontics. In the anterior part of the mouth, the load is not so great, and larger spans may be safely constructed even including the replacement of the four upper or lower incisors.

It may be somewhat surprising to the advocates of removable bridgework to learn that, in some cases of teeth which have lost some of their alveolar support, a fixed bridge may give better results than a removable bridge. But this is often the case. In spite of the claim which has been made by some of the profession that the fixation of abutments is detrimental to the health of the periodontium, it has been my experience that this fixation may be made actually beneficial if the case is carefully selected and if all occlusal trauma is avoided. With proper attention to the occlusion, with special reference to avoidance of undue buccolingual stress, the abutments of a fixed bridge will be found to afford each other a mutual support which will have a regenerative and not a destructive effect.

It has been my observation that, in this type of case, the removable bridge is usually injurious. I attribute this to the strain which is imposed during the insertion and removal of bridges even when the attachments are apparently perfectly paralleled. The removal of bridges even when the attachments are parallel necessitates great care on the part of the patient in regard to the direction of pull. It is difficult to instruct some patients as to how they may remove these bridges without producing dangerous strain on the abutments.

Fixed bridgework is nearly always indicated when one or both of the abutments are slightly tipped, provided the span is not too long. When tipping occurs, it will be evident that the tipped tooth is at a disadvantage from the standpoint of occlusal stress. Yet many such teeth give long years of service if the occlusion is properly adjusted, and they will even function satisfactorily as bridge abutments if the occlusion is correct. But when they serve as abutments for a removable bridge, they frequently develop mobility and periodontal disease as a result of the strain brought about by the insertion and removal of the bridge. This is probably complicated also by the lack of fixation to which reference has already been made.

While this paper is intended to deal with the indications for fixed bridgework, it may be proper to develop this point by citing cases in which removable bridgework is not indicated. The outstanding example is the case of a missing single anterior tooth. In nearly all such cases, the preparation of the abutment teeth to receive the female part of the internal attachment requires an unwarranted destruction of tooth substance. Clasp bridges are seldom feasible from either the mechanical or the esthetic standpoint. Hence, such a case is best restored by a fixed bridge. If the case is one which also involves the restoration of posterior teeth by removable bridgework, the single anterior tooth may be joined to the posterior structure. Even in these cases, it is usually more satisfactory to make a

separate fixed bridge to restore the anterior tooth.

In a case similar to the foregoing in which two anterior teeth are missing, as, for instance, the upper central incisors, the missing teeth may best be supplied as a part of the removable posterior bridge. In such a case, it is of course necessary to provide for the stability of the anterior pontics by making inlays for the lateral incisors having recesses to receive extensions of 19-gage wire soldered to the pontics.

An important point in the adjustment of a fixed bridge which has a porcelain pontic resting against the mucosa of the alveolar ridge is the amount of pressure which should be developed at this point. If the pontic does not make a firm contact with the mucosa, food particles will accumulate under the porcelain and give rise to fermentation. On the other hand, if the pressure is too great, a chronic irritation is produced which will cause pain and may lead to infection of the underlying tissue. The exact amount of pressure required can be determined only by trial of the bridge in the mouth. It should be set with temporary cement, the porcelain pontics being also set with temporary cement, and left in the mouth for two or three days. The bridge is then removed and the mucosa inspected. Porcelain may then be added or removed according to the indications. If porcelain is ground away, the surface must be reglazed before the bridge is set. This precaution should never be omitted, as unglazed porcelain provides an excellent breeding place for bacteria.

CONCLUSION

I strongly advocate fixed bridgework where the length of the span is within the supporting power of the abutment teeth. Experience has proved that fixed bridgework does not cause periodontal disease if the occlusion is properly adjusted. Finally, fixed bridgework does not lead to focal infection if the vitality of the pulps in abutment teeth is properly safeguarded, and if the sanitation of the piece is properly provided for. These things can be accomplished.

DISCUSSION

DeForest Davis, Cleveland, Ohio: The fixed bridge is one of our oldest means of tooth replacement. During the years of its development, there have been many improvements, until today the modern fixed bridge as described by Dr. Doxtater, when used where indicated, properly constructed and applied, can be said to meet all the requirements of health. We do observe fixed bridge failures, but these are rarely due to the fact that they are fixed, but have failed rather because of poor judgment and lack of skill on the part of the operator. This, of course, applies to all forms of bridgework, removable as well as fixed. Dr. Doxtater has laid down certain requirements, and, from my experience, I would say that whenever these requirements are fully met, we can be assured of success in this work. Among the other points which he brings out, he says that the first requisite in fixed bridgework is a consideration of the occlusion. It would be impossible to lay too much stress on this point. We know that teeth are sometimes lost through occlusal trauma when carrying only their own share of the occlusal load. Therefore, teeth which are acting as abutments, with their load at least doubled, should invariably be placed in the best possible occlusal relation. Dr. Doxtater tells us that, in order to establish a safe occlusion, it is sometimes necessary to reorganize the entire mouth. I find myself in entire agreement with him on this point. It is futile to expect success when we build bridgework to conform to a condition of malocclusion. This is done all too frequently and accounts for many a failure of an otherwise fine piece of work. I am sorry that Dr. Doxtater did not dwell at greater length on this point and tell us under what conditions the entire occlusion should be changed, and what method he would follow in doing it. It is a difficult thing to change the occlusion of an entire mouth. It calls for an unusual understanding of the working relation be-

tween the components of the dental mechanism, namely, the mandible, maxillae, muscles and teeth. I have seen some disastrous failures and have concluded that it is better to leave many cases unchanged than to attempt its reorganization without adequate preparation. Dr. Doxtater reminds us that a good fixed bridge does not jeopardize the health of the pulp. Too frequently, in our zeal for a fine mechanical operation, we forget that we are working on living tissue which reacts very quickly to undue irritation. The three-quarter crown is undoubtedly the best form of abutment that has been developed to date. With the hard golds available today, it is possible to make these crowns very thin without sacrificing necessary strength. The slice preparation as advocated by Dr. Gillett, Dr. Travis and Dr. Knapp has been a great help in conserving tooth structure in abutment preparations. In discussing the relative merits of fixed and removable bridgework, I once laid down six requirements or rules for fixed bridgework which might be of value here:[1] "1. The occlusion must be favorable. The importance of this cannot be overstated and it calls for correction either by grinding or, where this will not suffice, by rebuilding the entire occlusion to a new relationship, i. e., opening the bite. 2. The removal of the smallest possible amount of tooth structure in the preparation of abutment teeth, without sacrificing necessary strength. 3. The elimination of all pathological conditions. No diseased tooth should be used as an abutment for a bridge. 4. The construction of abutments and pontics in harmony with our understanding of tooth anatomy. 5. Complete accuracy must be attained in casting, impression taking, model making and soldering. The bridge must go to place without strain upon abutments. 6. The occlusion should invariably be carefully perfected by grinding with stones and milling with carborundum paste in the mouth after the bridgework is in place." Long spans where more than two pontics are carried on two abutments are usually unfavorable. Success here will depend on the extent to which the foregoing six conditions can be complied with, as well as to the quality and quantity of alveolar bone. Dr. Doxtater directs our attention to another important point when he says, "It may be somewhat surprising to the advocates of removable bridgework to learn that, in some cases of teeth which have lost some of their alveolar support, a fixed bridge may give better results than a removable bridge, but this is often the case. In spite of the claim which has been made by some of the profession that the fixation of abutments is detrimental to the health of periodontium, it has been my experience that this fixation may be made actually beneficial if the case is carefully selected and if all occlusal trauma is avoided." I believe that this statement is true because the looseness is frequently due to migration and tipping, and the placing of a fixed bridge definitely stops this movement. Of course, we are speaking here of a tooth which is only slightly loose and has lost practically none of its bony support. One of the purposes in attaching a bridge to a tooth which has tipped from its original position is to arrest the tipping movement. A fixed bridge is the only effective means of accomplishing this. Therefore, in these cases, a removable bridge of any type is contraindicated. As Dr. Doxtater has told us, "Many such teeth give long years of service if the occlusion is properly adjusted and they will even function satisfactorily as bridge abutments if the occlusion is correct. But when they serve as abutments for a removable bridge, they frequently develop mobility and periodontal disease as a result of the strain brought about by the insertion and removal of the bridge. This is probably complicated also by the lack of fixation, to which reference has already been made." I quite agree with what Dr. Doxtater says in opposition to replacing anterior teeth with removable bridgework. I am of the opinion that when one or all four of the upper or lower incisors are lost, they should be replaced with a fixed bridge. It is possible to meet all the requirements of beauty, strength and cleanliness with a minimum of inconvenience to the patient and danger to abutment teeth. It is necessary, of course, that the occlusion be favorable, but this is always necessary, regardless of the type of restoration being used. I wish to make a plea to the dental teacher. The progress we have made in the last twenty years has brought us to a point where today the well informed, skilful and conscientious dentist is placing fixed bridges with every assurance that they will give long service without injury to the structures to which they have been applied. He can do this because he understands the physiologic and mechanical requirements of health and possesses the facilities

1. Davis, O. DeF.: Dent. Cosmos, 70:16 (Jan.) 1928.

and skill to meet them. The student of today will be the practitioner of tomorrow. At present, he is in the hands of the dental teacher, who is carrying the responsibility of turning out a graduate equipped to meet the requirements of modern bridgework. I fully appreciate the numerous difficulties encountered by the dental teacher, and the impossibility of teaching a dental student to perform operations with the skill of an experienced practitioner. It should be possible to give the student a clear conception of what modern bridgework is, and instill in him a desire to meet its standards from the beginning of his practice.

Dr. Doxtater (closing): Regarding reorganization of the mouth: Cases which require the opening of the bite should be approached very cautiously. First, it is necessary to have a complete set of roentgenograms to detect possible pathologic conditions; especially alveolar resorption. Whenever the bite is raised, especially if we have to raise it very much, some sort of appliance should be made which is to be worn for a period of several weeks or possibly months. I have found that the best method for the construction of such an appliance is to secure a good impression of the occlusal half of the lower teeth. A cast of artificial stone is made. Tinfoil is burnished carefully over the occlusal surfaces and partly over the buccal and lingual. On this, a thin layer of hard rubber is vulcanized, the opposite sides being attached with a lingual bar. This splint is made very thin. No attempt is made to provide occlusion for the upper teeth. Next, a thin layer of compound is placed over the vulcanized surface. Then, we ascertain how much the bite is to be raised, reducing or adding to the compound as the case may require. When the proper height has been secured, the patient is instructed to go into the right and left as well as protrusive occlusion, and a slight amount of abrasive material is used over the compound to make the grooves and fissures which the cusps of the opposing teeth will produce in the modeling compound. I find this method more satisfactory than establishing the new relation on an articulator. The additional modeling compound is then vulcanized to the splint, and the patient is allowed to wear it for three or four hours a day or longer, until the jaw becomes accustomed to the new position. When the case is ready for reconstruction, a slight portion of the vulcanized splint is cut away and a posterior tooth or abutment is built up to conform to the new occlusion. Then, we go to the opposite side of the mouth and follow the same procedure, afterward alternating from one side to the other until several of the teeth to be used for raising the bite are built up to the proper height. The splint may then be discarded. In that way, it is possible to get an occlusal relationship that is very satisfactory. When raising the bite is questionable, even though the bite has become closed somewhat, if it is possible to secure a harmonious relationship in the patient's mouth by a moderate amount of grinding, I would advocate grinding cases rather than raising the bite. The decision depends on which procedure will require the minimum amount of sacrifice of sound tooth structure. There are many other things that could be mentioned, but the two most important questions are whether the bite shall be raised or whether harmonious relationship can be obtained with judicious grinding.

ESTHETICS OF FULL DENTURE CONSTRUCTION*

By F. M. WILLIS, D.D.S., Philadelphia, Pa.

THE first requisite in a set of dentures is the appearance. "How do they look?" is the first thing the patient asks. Of course, efficiency and comfort are of greater importance, but, on this occasion, I am considering esthetics only. It is well to bear in mind the psychologic effect on the patient of a good looking set of teeth; for most patients will endure considerable discomfort for the sake of appearances, especially woman patients.

In the first place, what makes artificial teeth look false? According to my observations, it is because: The bite is not opened enough; the teeth are too small, too light in shade, too short or too nearly uniform in set-up or in shade; the set-up is too wide in the bicuspid region; the curve of Spee or the prosthetic curve is not properly located or is entirely lacking, or the contour of the face is not fully restored. Thus, the face looks shortened, the mouth wide, the lips wrinkled, the cheeks sunken and the vermilion of the lips shows little or none. These are some of the defects that we undertake to remedy.

I take it for granted that artificial teeth must of necessity be slightly smaller than the natural teeth and a trifle shorter, and must occupy a position a little further back in the face. They must be smaller because they have to be set on a smaller ridge; shorter, because the lower part of the face has shrunk, and farther back, because the shrinkage beyond the edges of the dentures cannot be fully restored and the face will slightly resemble that of the gorilla unless the teeth are set slightly farther back than were the natural teeth. In other words we are dealing with a crippled condition, and the patient's loss cannot be fully compensated for in the artificial teeth. If there is an exception to this rule, it will be found in the case in which we insert dentures immediately after extraction and thereafter rebase and plump out as fast as shrinkage takes place. This, of course, would be the ideal way to handle every case, but unfortunately we are seldom able to do so, for obvious reasons.

Having outlined the limitations, I shall now undertake to establish a definite method of correctly opening the bite and restoring, as nearly as possible, the esthetic features which the patient has lost. My wish is to systematize and place on a teachable basis the unsolved problem of how much to open the bite. Dental literature is lacking, as far as my observation goes, in any definite teaching on this subject. Most of the demonstrating that I have seen has been wofully lacking on this point. We ought to be able to teach beginners a definite method of opening the bite to restore the contour of the face.

*Read before the Section on Full Denture Prosthesis at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 9, 1929.

The measurements that I am advocating are not new, but the method and accuracy of obtaining them with a bite-gage are new. When the adjusted bite-rims or the finished dentures are in the mouth, the distance from the base of the nose to the lower edge of the mandible should equal the distance from the pupil of the eye to the rima oris, or parting line of the lips. In measuring scores of cases having all the natural teeth in first-class condition, I have found that the measurement alluded to is approximately correct. At least, it gives us a definite basis on which to proceed, and I know of no other equally good.

Of course, if the patient's natural teeth are worn on the occlusal surfaces, or some of the teeth have been lost, the face is already shortened. The method that I am advocating enables us to restore the patient's face to normal, regardless of the condition we find when the patient comes in to have dentures made.

If we have the patient before extraction, it will be advantageous to preserve a record of the length of the face by photography, the roentgen ray, or the bent wire or silhouette methods; also to take an impression before extraction and remount the teeth on a plaster model. The study of these will help us later on, as we proceed with the case.

If the patient has been without teeth for some time or has worn dentures which are too short, the upper lip has become shortened and the rima oris is too near the nose. In order to get the correct distance from the pupil of the eye to the rima oris, it becomes necessary to build bite-rims too long, place them in the mouth and ask the patient to exercise the lips in various ways until the upper lip occupies as nearly as possible a normal position. In many cases, the upper lip needs to be brought down from 7 to 12 mm. or more. But I doubt that it is advisable to open the bite more than 6 or 7 mm. at any one time.

With the bite-gage, we measure the distance from the pupil of the eye to the rima oris, by having the sliding arm of the meter point in the opposite direction to the short arm at the end of the main shaft, allowing the movable arm to parallel the rima oris, the other arm being level with the pupil of the eye. Suppose this distance is 70 mm. In men, I find this measurement averages from 65 to 70 mm., and in women, from 60 to 65. Next, we measure from the base of the nose to the crest of the upper ridge. Let us suppose this measurement is 18 mm. The sliding arm of the bite gage is reversed so that it points in the same direction as the fixed arm on the shaft, and the distance from the crest of the lower ridge to the lower edge of the mandible is measured. This measurement, let us say, is 36 mm. Eighteen plus 36 equals 54; 70 minus 54 equals 16. Thus, the combined height of the two bite-rims is to be 16 mm. If the upper is 7 and the lower 9, the combined height is 16. The reason is that the lower ridge, being thinner, shrinks more rapidly. I have a quick and accurate way of measuring the height of a bite-rim with an instrument which I devised, taking an old pair of foil carriers with the points broken off, smoothing the broken ends off even, bending one end into a small loop, and sharpening the other end and bending it at right angles to the loop and with the sharp point just even with the loop end. The loop end is placed inside the trial plate and the point end outside on the bite-rim. The point is held close against the rim while the loop end is moved along the groove where the crest of the ridge rests. Thus, the level of the crest of the ridge can be marked in a

few seconds. This is a valuable point to a careful man.

We may proceed to use the bite gage in another manner, as follows: The bite-rims are built longer than is necessary, and tried in the mouth, the patient's lips being manipulated and the correct measurement obtained from the pupil of the eye to the rima oris. The lower rim is marked level with the lower lip and adjusted accordingly. The occlusal surface is oiled and the rim is returned to the mouth. The upper is removed, the entire occlusal surface is softened and it is replaced in the mouth, the patient being requested to close until the distance from the bottom of the nasal spine to the lower edge of the mandible equals the distance from the pupil of the eye to the rima oris, or parting line of the lips. Frequently, the upper rim has to be heated more than once to get the correct adjustment. This is the method that I usually follow.

It is a more or less well known fact that closure of the bite frequently causes deafness or a distressing buzzing in the ears. In all such cases, it is best to open the bite the full distance and maintain it as nearly as possible in this position. We have stopped an intolerable buzzing in the ears, or approaching deafness, in many cases, by opening the bite. In one case, I opened the bite 13 mm., and aside from a few days of slight inconvenience in eating, the patient suffered no annoyance. Neither of the dentures required any trimming on account of soreness. This was due in part to the accuracy of the impressions and bite, as well as the balance of the dentures.

I prefer to use a 4-inch spherical disk in forming the occlusal surfaces of the bite-rims to an approximate curve of Spee.

If the patient's face is of the square type, the bite-rims are built to conform to this type. The same course is followed for the ovoid, tapering or modified types, and the labial surface of the upper rim is carved so that it will appear slightly depressed in the region over the lateral incisors and the bicuspids, a distinct cuspid eminence remaining. Also the upper rim is slightly flared at the incisal median line; that is to say, the rim must slope outward from top to bottom. The lower rim is grooved out across the front, from the occlusal surface to the lower edge of the trial plate. In other word, the contour of the face is to be fully restored by the proper shaping of the bite-rim. It is much easier and much more definite to decide on the proper esthetics of the case now than to be careless at this stage and undertake to do it all in setting up the teeth. This is one point in the process of constructing dentures where the strictly mechanical has to give way to the artistic. And it is surprising how the artistic sense can be cultivated along this line. I have observed cases in which the dentist seemed to be almost devoid of any artistic sense, and after a few months' study along these lines, he developed unusual artistic skill.

With the bite-rims in the mouth, studious attention should be given to the following features, and the bite-rims adjusted accordingly: 1. The rima oris, or parting line of the lips. 2. The vermilion of the lips. 3. The nasolabial sulci. 4. The philtrum of the upper lip. 5. The tuberculum of the upper lip. 6. The bulge of the lips over the cuspid eminences. 7. The commissures. 8. The labiomental groove.

Most of these points will have been covered by opening the bite the correct distance. For instance, the rima oris will be shorter and the commissures closer to-

gether, and the vermilion will show more. The nasolabial sulci are to be preserved by the carving of the upper rim; that is, flattened over the lateral incisors and bicuspids, with a distinct cuspid eminence between. The philtrum must slope outward from under the nose to the middle point of the cupid's bow. The tuberculum, the middle point of the upper lip, must be the farthest point forward of the face, except the nose. The bulge over the cuspid eminences has been provided for in carving the upper rim. The labiomental groove, an important matter, has been provided for in the carving of the lower rim. If all these features are not correct, the bite-rims should be adjusted before we proceed with the case.

Centric occlusion must be decided by the method best suited to the operator. As there are hundreds of ways of accomplishing this, each one guaranteed not to fail, it might make this discussion too long to enumerate or describe them.

The case is now transferred to the articulator, and the esthetics of the bite-blocks is to be carefully reproduced in setting up the teeth. This is done by setting all the upper teeth first, giving proper slope to the anterior teeth with their incisal edges flush with the lower bite-rim, and the posterior teeth are set with the lingual cusps on a line drawn over the lower ridge, in the region of the bicuspids and molars. In the setting of the upper anterior teeth, the necks of the teeth should point as nearly as possible to the crest of the ridge. The lower are set in occlusion with the upper teeth, the overbite and overjet being made to conform to the requirements of the case. It is entirely possible to have the teeth in correct, balanced occlusion and still preserve all the esthetic features that I have described.

The type of the tooth should conform to the type of the face. I practice classifying people's faces at a glance, but I do not object to the dentist's using some measuring device if that is the best that he can do. For a long time, I classified the type of face of about 300 persons daily. It required nearly an hour for me to reach the office by street car. I classified about seventy-five persons, morning and night, on the street car. At noon, on my way to lunch, I classified about 150 more. I found more in the tapering and modified tapering types than in any other class. According to my notion, the most beautiful women have faces of the ovoid type. More men than women classify as having square faces.

The length of tooth, ridge lap, incisal edge and lingual slope of the anterior teeth should be taken into consideration. The length and type of tooth to be used can be much more easily determined when we have a reliable bakelite or resinous base, which is translucent and is an exact imitation of the natural gum. We have already tried some of these bases and they looked well enough to satisfy the most critical, but their permanence is yet to be proved.

As long as we are obliged to continue the use of vulcanite, we must use a tooth long enough and of a type to prevent, as far as possible, any show of vulcanite.

The width of the upper anterior teeth can be judged by the width between the corners of the mouth, as marked on the bite-rim. But I never decide by this alone. I invariably set the six upper anterior teeth on a trial plate of wax and try it in the mouth, before deciding. Here again, mechanics must give way to the artistic. The usual mistake of using teeth which are too small is to be avoided.

For persons of a pallid skin, a gray shade is employed; for ordinary pink skins, a yellow shade, and for persons of extra vigorous looks, a combination of gray, yellow and pink. Of course, the depth of the shade should vary according to the age of the patient. I mix the shades in every set of teeth that I make, and in all cases except in younger persons, I even make the upper central incisors slightly different from each other. I use the accompanying formulas for mixing shades. I use this guide because it suits my scheme of mixing shades better than any other. For instance, the first seven shades are gray, graduated from light to dark; the next eight shades are yellow; the next four are yellow-gray-pink. So I can easily vary the shades within each group.

This is just a suggestion. The operator should use his own judgment if he thinks it is better.

Manufacturers are unable to furnish teeth of mixed shades, for the obvious reason that no two dentists would agree as to the right mixture. Hence, it becomes necessary to purchase teeth in 6's and 8's and do our own mixing. This will not add to the expense because, when the stock of teeth becomes ragged from mixing the anterior teeth, we can have the sets filled in with no extra cost.

In explanation of the first formula: The basic shade is 16. The upper right cuspid is 18; the right lateral incisor, 16; the right central, 16; the left central, 17; the left lateral, 16; the left cuspid, 18. The lower right cuspid is 18; the right lateral, 16; the right central, 18; the left central, 16; the left lateral, 16; the left cuspid, 18. The posterior teeth may be of the basic shade or one shade darker. In some cases, I mix the shades of the posterior teeth also.

I use the following formulas for giving irregularity to the set-up: For the ovoid type, I depress one central incisor and slightly lap both lateral incisors and both cuspids. For the tapering type, I

S. S. WHITE SHADE GUIDE

Patients 45 to 50 years of age, use basic shade 16	18	16	16	17	16	18	Posterior teeth 16 or 17
	C	L	C	C	L	C	
	18	16	18	16	16	18	
Patients 50 to 60 years of age, use basic shade 17	19	17	17	18	17	19	Posterior teeth 17 or 18
	C	L	C	C	L	C	
	19	17	19	17	17	19	
Patients 60 to 70 years of age, use basic shade 18	19	18	18	19	18	19	Posterior teeth 18 or 19
	C	L	C	C	L	C	
	19	18	19	18	18	19	
Patients 35 to 45 years of age with pink skin, use basic shade 11	12	11	11	13	11	12	Posterior teeth 11 or 12
	C	L	C	C	L	C	
	12	11	12	11	11	12	
Patients 35 to 45 years of age with pallid skin, use basic shade 2	4	2	2	3	2	4	Posterior teeth 2 or 3
	C	L	C	C	L	C	
	4	2	4	2	2	4	
Old persons requiring brownish yellow shade, use basic shade 21	22	21	21	22	21	22	Posterior teeth 21 or 22
	C	L	C	C	L	C	
	22	21	22	21	21	22	

twist the distal of the central incisors outward, depress both lateral incisors and lap both cuspids. For the square type, I set up the teeth in regular square form, and after vulcanization, I use a thin disk and make a permanent separation between the central and the lateral incisor on one side and the lateral incisor and the cuspid on the other.

As to length, in both the ovoid and the tapering types, I set the lateral incisors a little shorter and the central incisors and cuspids slightly longer. A little variation in what I call the skyline of the teeth helps wonderfully in producing a natural look.

I have one formula for changing the set-up of the lower anterior teeth, varying it slightly in different cases. I twist the right lower lateral incisor outward at the mesial edge, doing the same for the right central incisor, set the left central incisor normally and twist the left lateral incisor outward at the mesial edge. This is facilitated and the width of the four incisors is made narrower by properly grinding the edges; for instance, the distal-labial edge and the mesial-lingual edge of the right lateral incisor. The right central and the left lateral incisor are to receive the same treatment. The necks of all the lower incisors should point to the crest of the ridge, so it often becomes necessary to have considerable overjet in order to meet properly the esthetic requirements of the case.

Staining the teeth with low-fusing stains is another successful method of varying the shades of teeth. As the fusing point of these stains is 1,650 F., in order not to disturb the fixedness of soldered-in pins the dentist must use a furnace with an accurate and reliable pyrometer.

Staining is easily accomplished and requires no particular training. In fact, the dentist who applies the stains moderately and without any regular system is likely to get the best results. Nature never stains all natural teeth according to system. We should apply the stain to the gingival portion of some of the teeth, to the proximal of others and on the face of others.

To start, a fifty-fifty mixture of white and yellow stain with a trace of brown added should be used. To increase the density of the color of the stain, the brown in the mixture is increased. It is painted on with a brush and carefully fired in the furnace.

According to my judgment, a variation in the shades of the teeth, particularly the anterior, both upper and lower, adds much to the esthetics of the case. The younger the patient, the less the variation in shades, but in older persons the shading can be varied considerably.

In dealing with the mouth, we are dealing with the most expressive feature of the face, and it becomes our duty to give it diligent study and approximate nature as nearly as possible.

The financial reward is not all we receive for making an artistic set of dentures which will function properly for the patient. We have the satisfaction of restoring the patients' looks, of adding to their comfort and the pleasure of eating, and, in many cases, we prolong the life of the patient. If we live up to the standard set, our reward will be great.

DISCUSSION

E. H. Bruening, Omaha, Nebr.: Dr. Willis has presented a paper containing so much matter of vital importance to him who seriously wishes to make better dentures, particularly in the sense of improving the appearance of the unfortunate wearer, that it will require careful study within the undisturbed limits of one's home or office to understand the import of what he has brought to us. In addition to the many reasons for the unpleasant appearance of the faces of our

patients who are wearing artificial dentures, I would like to mention the loosefitting upper denture which the patient must subconsciously hold in place by almost constant pressure of the upper lip. This may cause atrophy of lip tissues, producing the very unpleasant thin upper lip, and also the vertical markings around the mouth that indicate to all that the individual has lost his teeth. In a general sense, less prominence must be given to artificial teeth in size, position and color, because there is a marked difference in the refraction of light, comparative translucency and relative background. This applies also in cases of immediate denture restoration. Dr. Willis' method of obtaining approximate measurements is highly commendable, and is well worthy of careful study on our part. Textbooks of art, as understood by the sculptor and the painter, tell us that all things have one of three forms or combinations of these. These forms are represented by the triangle, the square and the circle. From this, you will recognize the foundation of J. Leon William's work describing face and arch form as tapering, ovoid and square. By carefully observing the faces that pass before us, we will readily become familiar with these types and their modifications, and will thus be greatly aided in choosing and setting teeth. I have found that I can get better results from the study of face form with the use of photographs and printed pictures of faces as they appear in our newspapers and magazines. It is a simple matter to accumulate hundreds of specimens with the use of scrapbooks. Each face, especially those of prominent people, can tell an interesting story to him who takes a little time to study them. I would like to again bring to the attention of the members of this section the value of a camera in the office of the man who is particularly interested in improving facial appearance with the use of artificial teeth. The process is simple and the results are most satisfactory.

John B. La Due, Chicago, Ill.: Of the three requisites for success in artificial denture construction, comfort, appearance and efficiency, the average patient displays more concern regarding appearance. This does not apply wholly to our women patients, for we find that men are many times even more meticulous. Producing harmony in esthetics in artificial dentures is an art, and the results obtained are limited to the operator's ability. There are certain fundamentals, but largely it evolves into a personal equation developed by study. The selection of teeth, choosing of shade and hue, study of facial proportions, and the proper position of the teeth in the arch as regards light and shade all play an important part. Slight rotation of the teeth makes an apparent difference in hue in teeth of the same shade, and gives individuality to each tooth. I prefer this method to that of abruptly breaking shades. Shadows thrown by the lips must not be overlooked. Effects which call particular attention to the case should be eliminated, for these accentuate artificiality. The study of esthetics is of most importance, but effects that we see every day clearly demonstrate that little time and attention is given to it by many operators.

THE EXPEDIENCY OF DIAGNOSTIC AND POSTOPERATIVE ROENTGENOGRAPHIC EXAMINATIONS IN EXODONTIA*

By CLARENCE O. SIMPSON, M.D., D.D.S., F.A.C.D., St. Louis, Mo.

THE first dental operations were for the removal of teeth, and, principally because of neglect, these operations still constitute a large proportion of dental practice. During the last forty years, more progress has been made in operations for the removal of teeth than in the preceding centuries of civilization, until the practice is now a most enthusiastically pursued specialty. The improvements are in the administration of general anesthetics, the development of conduction anesthesia, the application of asepsis, the refinement of surgical technic, the perfecting of instruments and the use of roentgenography. Anesthesia and asepsis are compulsory advancements to render the operations more endurable and the results more favorable. The improvement in operative procedures and instruments is the evolution from ingenuity applied to mechanical problems. Roentgenography is an aid which greatly extends the scope of anatomic knowledge, diagnostic information and postoperative observation.

It is incredible that an agency which, with little effort, will reveal evidence unobtainable by other means and which influences the success of the operations should be only partially utilized. The advantages of routine roentgenographic examinations before and after the removal of teeth have been presented, and the procedure has been adopted by many operators with most gratifying results. The observations in a radiodontic practice conclusively demonstrate that negligence in this duty still prevails. The evidence consists of retained root fragments, septic crypts, unsuspected cysts, foreign material in the alveoli, excessive destruction of process, injuries to adjacent teeth, sequestrums, breaks in the floor of maxillary sinuses, fractured mandibles and diseased teeth.

Probably the reasons for disregarding the assistance of roentgenography are the natural inclination to shirk extra tasks and an unreasonable optimism as to an ability to dispense with it. Because some teeth are easily removed and no disturbance ensues, it is assumed that roentgenographic examinations are superfluous, until complications arise.

This assumption does not conform to modern practice, which demands preventive, precautionary and efficient methods. The period has passed when the relief of pain instead of conservation of teeth was the function of dentists; when guessing was a substitute for diagnosis, and when bungling was accepted for systematic technic. Under the present régime, roentgenography is indispensable. When balanced diet produces perfect teeth and

*Read before the Section on Oral Surgery, Exodontia and Anesthesia at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 9, 1929.

precludes caries, and balanced occlusion eliminates trauma and prevents periodontoclasia, there may be no need for radiodontia—or dentists. In the meantime, every aid should be utilized to control destructive processes and to eradicate disease.

Ocular inspection and instrumental examination of teeth which are to be removed disclose only the external state of the crowns, the condition of the gums and the stability of the attachment. Such superficial examinations are quite inadequate for operative purposes, and the information derived is negligible in comparison with that from roentgenograms. Preoperative roentgenographic examinations reveal the number, form, and size of roots, or just what is to be removed and how the force is to be applied. They show the structure and amount of bone retention, which determines the resistance to be overcome. They disclose the periapical condition of all the teeth in the region and the indications for curettage. They present the relation of roots to the anatomic landmarks of which the maxillary sinuses and mandibular canals are of special significance. They expose the location and position of unerupted teeth. This information is a prerequisite for diagnosis, skilful operating and avoiding accidents in the removal of teeth.

The factors which cause preoperative roentgenographic examinations to be neglected apply even more generally to postoperative examinations. It is exceptional for roentgenographic records to be made after the removal of teeth, unless accidents occur or subsequent reactions demand them. Regardless of the care and skill employed, there is a possibility of unsuspected complications which retard healing. Root or enamel fragments, particles of filling material or fractured process may be left in the alveoli. These are easily removed at the time of the operation and are likely to cause disturbance if retained.

When there is extensive involvement of the bone, the examination immediately after the removal of the teeth should be supplemented by at least another, about six months later, to determine whether or not the repair has progressed satisfactorily.

When marked inflammation or suppuration ensues, roentgenographic examinations should be made sufficiently often to keep the bone developments under observation. The evidence of postoperative examinations is essential for the welfare of patients and the protection of operators, and it is foolhardy to ignore it.

The only system by which the maximum assistance can be obtained from roentgenography is the adoption of the examinations as a routine measure in the removal of teeth. This is justified by the proportion of cases in which the information is essential to the success of the operations, and in every case, the examinations are a safeguard which is obligatory in conscientious service. The data obtained would increase the knowledge and perhaps alter conceptions of bone regeneration in edentulous regions. The theory that repaired alveolar bone which differs in density and structure from the original is diseased has not been demonstrated by improvement after surgical treatment. There is a distinction between lack of repair due to disease and modified structure resulting from reduced stress, which must be considered in the interpretation. There is also a field for investigation in the time required for bone regeneration in different types of lesions and operations. Unless the reparative progress which may be expected under the existing conditions is known, pathologic interference and the indications

for treatment cannot be recognized.

Dentistry has been too much on the defensive, often in a disorderly retreat. We have attempted to save pulps after they were infected, to treat teeth after they were abscessed, to retain teeth after they were doomed by periodontoclasia, and to remove teeth or parts of teeth after operative complications which could have been avoided. Blindfold tests are not effective in oral diagnosis, as they are claimed to be in choosing cigarets, and the enterprising dental periodicals are advertising the secret process brand of cigarets instead, probably because secret remedies have been so profitable. Remedies, secret or otherwise, will be needed less when precautionary service prevails. It is time that dentistry maintain an offensive campaign by preventing instead of only trying to correct disorders, and roentgenography is a major factor in attaining this goal.

DISCUSSION

J. A. Blue, Birmingham, Ala.: Dr. Simpson has given us a timely paper, one which contains an ideal, but how many members of the profession are living up to it? He has made a plea for us to use every means at our command to render the best possible service to our patients. A preoperative roentgen-ray examination is of great value, as many abnormalities are revealed which, if blindly treated, would end in grief and failure. If the complications are known, a technic may be followed which will conserve the osseous structures as well as the dentist's time, and prevent suffering and untold annoyance to the patient. Postoperative roentgen-ray examinations are not made so often as they should be. I do not agree with Dr. Simpson that the procedure is essential in all cases, but I admit that it is the ideal. Many cases should be checked up at intervals and followed through as he has suggested.

THE MORPHOLOGY OF THE GINGIVAE OF THE RAT MOLAR*

By WILLIAM G. SKILLEN, D.D.S., Chicago, Ill.

SINCE Gottlieb[1] first threw new light on the normal anatomy of the gingivae, a great deal has been written on the subject. Up to a certain point, the opinions of those who have studied the subject first hand coincide more or less fully. They agree that the old conception, that from the time the tooth began to erupt there existed a pocket (crevice or subgingival space) between the gingiva and the enamel which extended to the enamel-cemental junction, is no longer tenable. On the other hand, it is generally agreed that a continuity exists between the epithelium lining the inner or tooth surface of the gingiva and the enamel, and later, when the epithelium grows down along the root of the tooth with the cementum. It is further conceded that, under ideal conditions, if a pocket exists at all, it is very shallow; that it does not extend to the enamel-cemental junction, but that below it the remainder of the epithelium is attached to the surface of the tooth.

*From the Histologic Department of Northwestern University Dental School.

1. Gottlieb, Bernhard: Der Epithelansatz am Zahne, Deutsch. Monatschr. f. Zahnheilk., 1921, p. 142.

This tissue which lines the inner or tooth surface of the gingiva and which is attached to the tooth surface is the enamel epithelium. With the atrophy of its typical cells, the ameloblasts, it assumes an appearance similar to that of stratified squamous epithelium and thus appears to be a continuation of the mouth epithelium. Because of the adherence of this epithelium to the tooth surface, Gottlieb[1] gave it the name "epithelial attachment." This term has been generally accepted and therefore will be used here.

There is some room for discussion of the practical importance of this subject, and there is, indeed, much disagreement over certain of its features. These will not be entered into here. Apparently, there remains something to be learned in regard to the anatomy of the gingivae, and this discussion will occupy itself in describing what this appears to be in the molars of the rat.

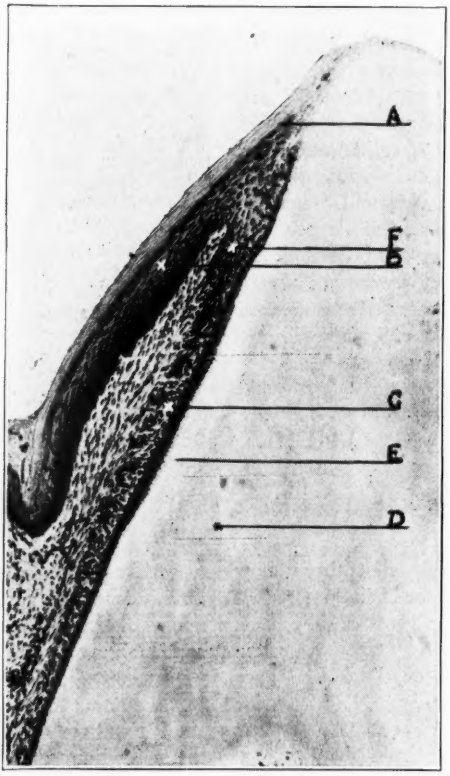

Fig. 1.—Beginning eruption in a 19-day-old rat. *A*, crest of gingiva continuing over tip of cusp as a homogeneous layer; *F*, proliferating mouth epithelium *(B)* uniting with basal layers of epithelial attachment *C*; *E*, enamel space; *D*, dentin.

The essential facts mentioned above apply as well to the material under discussion here as they do to many other

types of teeth. It is only in the details of the changes which occur as eruption progresses that it varies from what has been described elsewhere.

That which will be discussed here, therefore, is the formation of the cuticle, primary and secondary; the separation of the epithelium from the tooth surface as the tooth erupts; pocket formation, and, lastly, proliferation of the epithelial attachment along the root. This contribution to the morphology of the gingivae is based upon a study of the buccal and lingual surfaces of about 500 molars of rats ranging in age from 19 days to approximately 3 years.

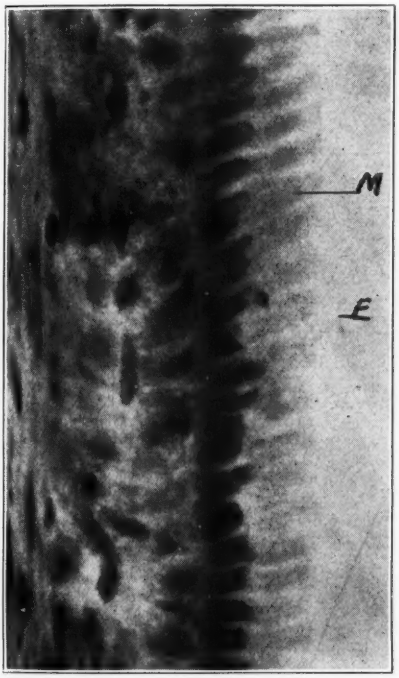

Fig. 2.—Area from Figure 1. The ameloblastic cuticula is absent. *M*, ameloblasts; *E*, enamel space.

FORMATION OF THE PRIMARY CUTICLE

Gottlieb[1] was the first to use the term "primary cuticle." He described this cuticle as the last product of the ameloblastic layer of the enamel epithelium, this epithelium, as has been pointed out,

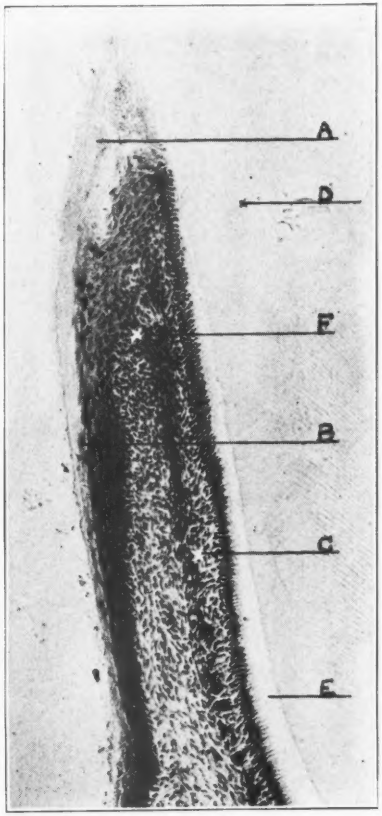

Fig. 3.—Section from 19-day-old rat, but at a little later stage of eruption than in Figure 1. *A*, crest of gingiva; *D*, dentin; *F*, proliferating mouth epithelium uniting with basal layers of epithelial attachment *C*; *E*, enamel space.

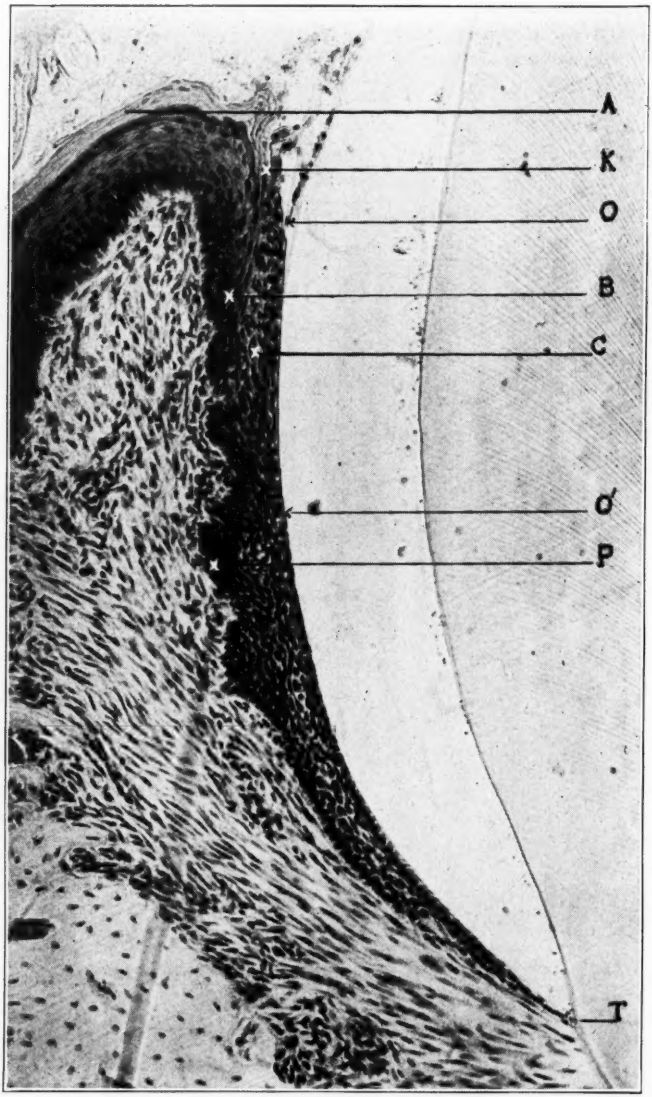

Fig. 4.—Section from 25-day-old rat. *A*, crest of gingiva and keratinized layer of mouth epithelium; *K*, deepest point of growth of keratinized layer of the proliferating mouth epithelium *B*, which is growing down behind the epithelial attachment *C; O* to *O'*, primary cuticle; *P*, proliferating basal layers of epithelial attachment; *T*, enamel-cemental junction.

constituting the epithelial attachment when the tooth erupts. Orban[2] makes the same statement, but goes on to say that this cuticle has the same properties as the organic matrix of the enamel and is therefore subject to calcification, a fact which, he states, may account for its nonappearance in some instances. In a study of dog material,[3] I visualized this cuticle as the remains of the ameloblastic cuticula of J. Leon Williams,[4] while Becks,[5] from observation of material from the same animal, considers it the product of a change in the ameloblastic layer. Some doubts are expressed as to its existence at all. Neuwirth,[6] with apparently a wide range of material at his disposal, does not believe it exists. Welikanowa,[7] after a study of dog and cat material, pronounces it an optical illusion.

In the material here under discussion, nothing simulating the very delicate structure known as the primary cuticle puts in an appearance until the ameloblasts have disappeared. This occurs, apparently, shortly after the tooth has broken through the overlying gum tissue. Neither is there such a structure as an ameloblastic cuticula to be observed during the time that the ameloblasts retain their typical form and appearance (Fig. 2), although such an appearance as that described by Welikanowa[7] may sometimes be observed, especially in thick sections.

From what can be observed in this material, it would seem that the primary cuticle consists of the atrophied remains of, at least, the ameloblastic layer.

Figure 1 shows the stage at which the tooth breaks through the gum tissue, and Figure 2, a little later stage, the two illustrating second and first molars, respectively, at 19 days of age. At *A*, the crest of the gingiva, the mouth epithelium *B* has fused with the epithelial attachment *C*. The latter retains its typical enamel epithelium characteristics. Over the tip of the cusp extends a homogeneous layer of tissue apparently consisting on the whole of the keratinized layer (*stratum corneum*) (*K*) of the mouth epithelium, with some of the atrophied elements of the enamel epithelium, all of which has the same appearance; i. e., that of a keratinized tissue. Extending from a point a little below the crest (*A*), the enamel epithelium preserves its characteristic appearance to the enamel-cemental junction, at which point it terminates. No structure resembling either an ameloblastic cuticula or primary cuticle can be observed. Figure 3, representing a little later stage, shows similar conditions, and Figure 2, an area from Figure 1, indicates an entire absence of any terminal process on the surface of the ameloblasts (*M*).

Figure 4, taken from a second molar of a 25-day old rat, shows the primary cuticle putting in an appearance. From *O* to *O'*, the ameloblasts have entirely disappeared, while below the latter point,

2. Orban, Balint: Dental Histology and Embryology, Ed. 1, Chicago: Rogers Printing Company, 1928; pp. 28 and 113.

3. Skillen, W. G.: Normal and Pathologic Anatomy of Investing Tissues Relative to Chronic Pericementitis, J.A.D.A., 13:1569 (Nov.) 1926. Skillen, W. G., and Mueller, Emil: Epithelium and the Physiologic Pocket, ibid., 14:1149 (July) 1927.

4. Williams, J. L.: Dent. Cosmos, 38:101-127 (Feb.) 1896.

5. Becks, Hermann: Normal and Pathologic Pocket Formation, J.A.D.A., 16:2171 (Dec.) 1929.

6. Neuwirth, Franz: Die Schmelzmembran u. der Epithelansatzam Zahn, Ztschr. f. Stomatol., 1925, pp. 318-363.

7. Welikanowa, M.: Zur Frage der Histogenese der Nasmythischen membran, Deutsch. Monatschr. f. Zahnheilk., 1928, p. 1073.

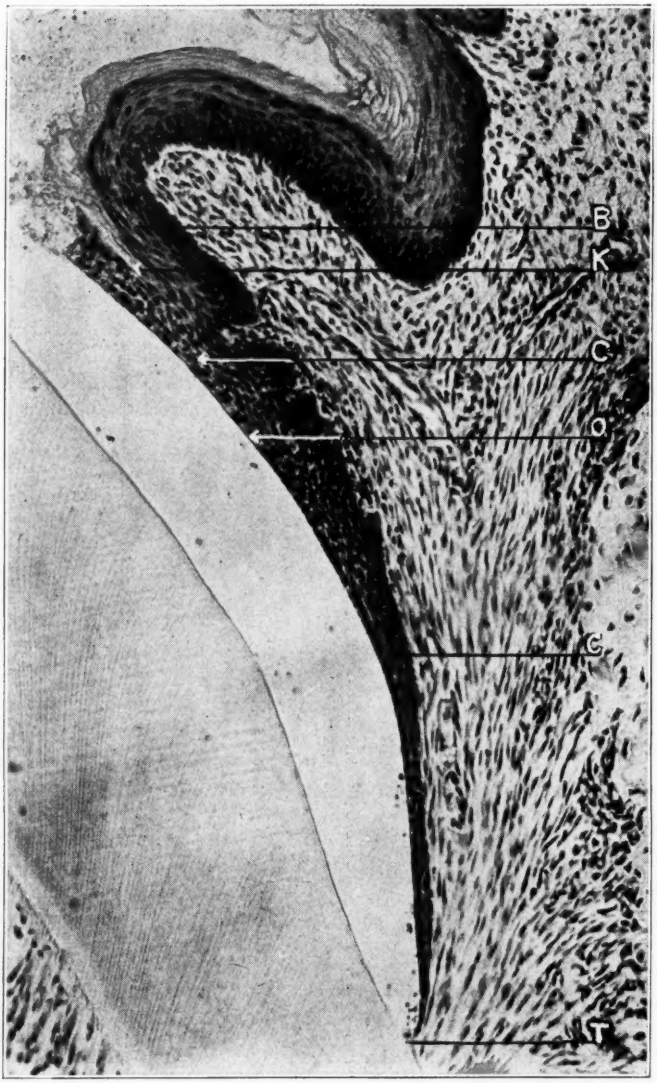

Fig. 5.—Section from 25-day-old rat. *B*, proliferating mouth epithelium growing down behind the epithelial attachment *C*, which is beginning to degenerate; *K*, deepest point of growth of keratinized layer of *B*; *O*, primary cuticle; *T*, enamel-cemental junction.

the typical columnar form of these cells has become altered. In the place of the ameloblasts appears a thin, dark line, plainly seen from *O* to *O'* in Figure 4, and again to be seen at *O* over a greater field in Figure 5, and in Figure 6, an area from the latter. At *A*, in Figure 6, it is seen to lie free of the adjacent tissue. This fine dark line is assumed to be the primary cuticle. It has much the same appearance as that membrane which is frequently left behind by the decalcification of the enamel of dog material, and to which, many times, as occurs in Figure 4 above the point *O*, cells of the epithelial attachment adhere. In the rat, the primary cuticle, because of its relation to other structures, is not easily distinguished in later stages of development.

It would seem, then, that the primary cuticle in the rat molar represents the atrophied remains of, at least, the ameloblastic layer of the enamel epithelium. Other layers may, of course, sooner or later unite in increasing its thickness. This cuticle, apparently, is strongly adherent to the enamel, and, in turn, the remaining portion of the enamel epithelium or epithelial attachment adheres more or less firmly to it.

FORMATION OF THE SECONDARY CUTICLE

During the subsequent stages of eruption, the epithelial attachment separates slowly and smoothly from the tooth surface; which means, of course, from the primary cuticle, if such is present. Gottlieb and his co-workers[8] say, further, that before this separation occurs, another cuticle may be formed, to which they gave the name "secondary cuticle," in the region of the enamel, but to which they also gave the name "cuticula dentis" because of its development in the region of the root after the epithelial attachment had proliferated down the surface of the cementum. Although this cuticle seems to develop quite constantly in man, it has not as yet been observed in some animals, especially the dog and the cat. In the latter, the primary cuticle only seems to be formed.

Although the various statements which appear in the literature describing the formation of the secondary cuticle express much the same idea, the exact origin of this structure is left in some doubt. The foregoing writers state that the membrane arises as a result of hornification of the superficial layers of either the outer enamel epithelium or the layer forming the epithelial attachment, both of these statements appearing in their writings, and probably meaning the same thing. Orban,[9] again, says it is built by the stratified squamous epithelium of the epithelial attachment and by reason of its origin is a keratinous substance. Häupl-Lang[10] believes it to be a result of keratinization of the surface layers of the enamel epithelium, and Neuwirth[6] that it is formed by the separation of the surface layers of the enamel epithelium, these layers being made up chiefly of the ameloblasts. These statements, taken all in all, probably mean that the secondary cuticle arises as a result of keratinization of the superficial layers of the epithelial attachment.

Becks,[5] in discussing the subject of pocket formation, with which, as with separation of the epithelium from the

8. Footnote 1. Orban, Balint, and Köhler, J.: Die physiologie Zahnfleischtasche, Epithelansatz u. Epitheltiefenwucherung, Ztschr. f. Stomatol., 22:353-425, 1924. Orban, Balint: Schmelz. u. Zahnoberhäutchen. Schmelzlamellen u. Büschel, ibid., 24:136-167 (Feb.) 1926.

9. Footnote 2, p. 115.

10. Häupl-Lang: Marginale Paradentitis, Berlin: H. Meusser, 1927, p. 38.

tooth surface, formation of this cuticle is associated, presents an entirely new picture of the process. He says, in brief, that the mouth epithelium grows down behind the epithelial attachment, and

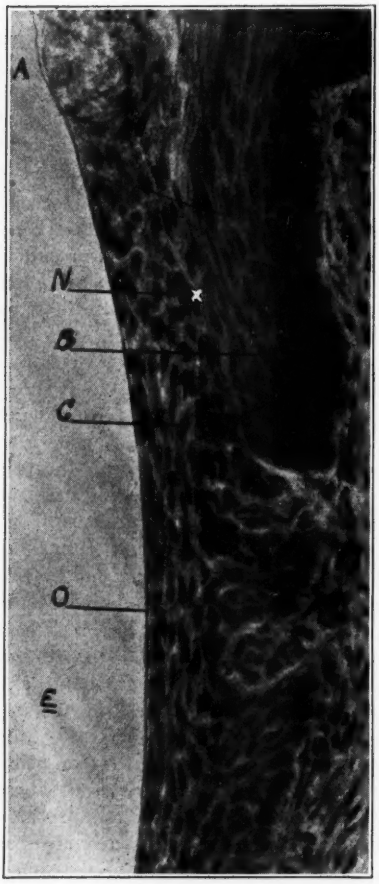

Fig. 6.—Area from Figure 5. *N*, line of demarcation between proliferating mouth epithelium *B* and degenerating epithelial attachment *C; O*, primary cuticle; *E*, enamel space; *A*, area toward crest of gingiva.

that the latter slowly degenerates, forming in part or wholly, in man at least, the secondary cuticle. He is not certain about the order in which these changes occur. Nowhere else in the literature are such steps described, although, here and there, something approaching them is hinted at, and, as Beck states, many illustrations used by other writers show somewhat similar conditions. For instance, Orban,[11] in describing the teeth of the rabbit, makes the statement that a part of the keratinized layer remains attached to the tooth surface as the cuticle and a part forms a keratinized layer for the epithelium. Orban and Köhler[12] also say that a heavy layer of horn cells is divided into two parts, one part adhering to the pocket epithelium and the other to the tooth. They further state that the keratinized layer of the mouth epithelium sometimes extends into the pocket and describe in the dog a degeneration of cells between the epithelial attachment and the cuticle. Mueller and I[13] presented very similar pictures in describing conditions in the erupting incisors of the rat. All of these descriptions agree somewhat with the findings of Becks, as do also the changes which occur in the gingivae of the rat molars as eruption progresses.

In the rat molar, the secondary cuticle, this term being used here as pertaining to the enamel region only, appears to be formed from the entire epithelial attachment as the result of a slow, gradual atrophy of this tissue. Its formation is closely associated with a proliferation of the mouth epithelium downward behind the epithelial attachment.

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11. Orban, Balint: Der Histologische Bau des Kaninchengebisses, Vierteljarsschr. f. Zahnheilk., 1925, pp. 263-287.

12. Footnote 8, second reference, p. 370.

13. Skillen, W. G., and Mueller, Emil: Findings in Studies of Tooth Development, J.A.D.A., 16:105 (Jan.) 1929.

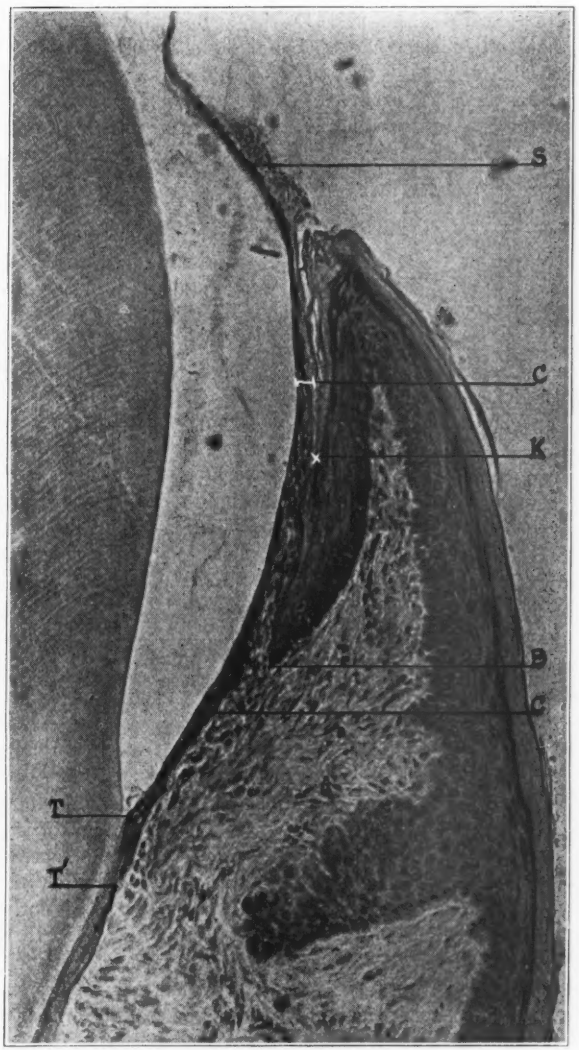

Fig. 7.—Section from adult rat. *S*, secondary cuticle, which is continuous into the degenerating epithelial attachment *C; K*, deepest point of growth of keratinized layer of proliferating mouth epithelium which terminates at *B*. There is proliferation of the epithelial attachment along the root from *T*, the enamel-cemental junction, to *T'*. No inflammation is present.

According to this material, the first step in the process seems to be the proliferation of the mouth epithelium. Figures 1 and 3, very early stages in the eruption of the tooth, show that this proliferation has already begun (*F*). In these particular instances, the proliferating tissue seems to be uniting with the basal layers of the epithelial attachment (*C*), an arrangement which does not always persist. At this stage, no great change can be observed in the epithelial attachment except over the tip of the cusp where pressure no doubt is exerting an influence.

Figures 4 and 5 show later stages. Here, the proliferating mouth epithelium (*B*) has advanced farther down behind the epithelial attachment (*C*). In Figure 6, the line of demarcation (*N*) between the two epitheliums is clearly shown. Degenerative changes are not strongly marked as yet, although they are a little more apparent in Figure 5 than in Figure 4. Injury by a foreign body has induced, at *P*, Figure 4, some proliferation of the basal layers of the epithelial attachment. This injury was not responsible for any of the other changes noted here, as similar conditions prevail in Figure 5, in which no injury of the epithelium could be observed.

Subsequently to proliferation of the mouth epithelium, keratinization of its surface takes place with or without a preceding development of keratohyalin granules. In Figure 4, this layer terminates at *K*, while in Figure 5, a little later stage of development, it extends somewhat deeper.

As degeneration of the epithelial attachment proceeds, this tissue assumes much the same appearance as the keratinized layer of the mouth epithelium, becoming more or less indistinguishable from it. This is shown to good advantage in later stages (Figs. 12-14), with intervening periods of development appearing in Figures 7-10 (*C*). In Figures 7, 8 and 11, the base of the proliferating mouth epithelium (*B*) is separated from the epithelial attachment (*C*) by a papilla of connective tissue. On the other hand, in Figures 10, 12 and 13, the demarcation between the two epitheliums is obscured because of their close fusion. In Figures 7-8, the atrophied epithelial attachment, together with some of the keratinized tissue of the mouth epithelium, extends above the crest of the gingiva as the secondary cuticle (*S*). In Figure 13, the epithelial attachment has atrophied to a point a little above the enamel-cemental junction *C'*, with the position of the proliferated mouth epithelium undetermined. In Figure 14, the latter tissue terminates about at *B*, a short distance below the enamel-cemental junction, while degeneration of the former has approached approximately the enamel-cemental junction (*C*).

It is always more or less difficult to determine from material whether or not an actual pocket existed *in vivo*. In the material under discussion here, no pocket seemed to have existed except in those instances in which a foreign body had injured the tissues. The keratinized surface of the proliferated mouth epithelium seems to be a weak point in the composition of the tissue, because, in the preparation of the material, tearing of the tissue seemed to consistently follow this line. (Figs. 7, 10, 13, 15 and 16.) In Figure 11, separation, which in part may have existed *in vivo*, has exposed almost the entire keratinized layer of the proliferated mouth epithelium. At *O*, most of the tissue at the epithelial attachment has been lost, a thin structure remaining which may possibly represent the primary cuticle. In Figure 15, a pocket may have

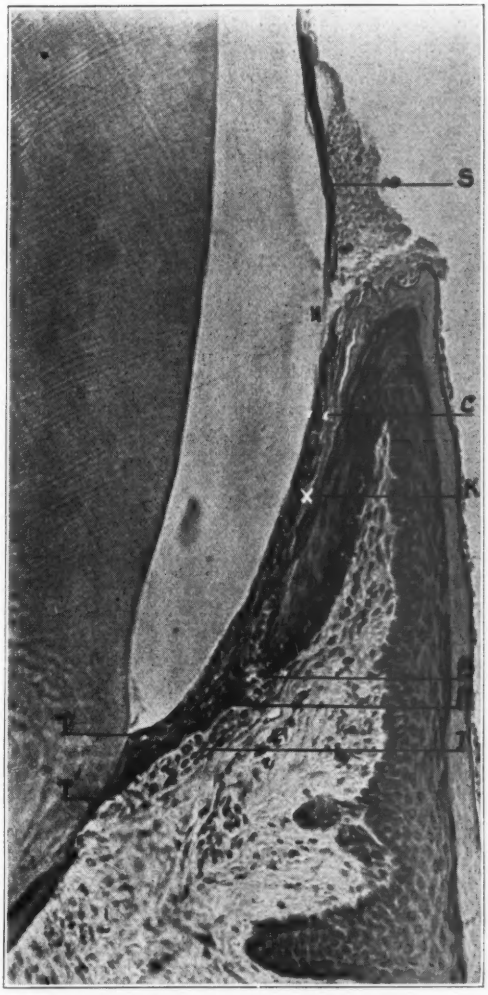

Fig. 8.—*S*, secondary cuticle, with a thick mass of the keratinized layer of the mouth epithelium attached and an artefact at *X*; *C*, degenerating epithelial attachment; *K*, deepest point of growth of keratinized layer of proliferating mouth epithelium which terminates at *B*; *P*, proliferating basal layers of epithelial attachment; *I*, area of inflammation. The epithelial attachment has grown along the root from *T*, the enamel-cemental junction, to *T'*.

existed *in vivo* from *A*, the crest of the gingiva, to *T*, the enamel-cemental junction, the rest of the separation shown here being produced during preparation. Because of this apparent weakness, the keratinized surface of the mouth epithelium might be considered a potential pocket, or, at least, the line along which

separation of the mouth epithelium from the epithelial attachment takes place.

To recapitulate, then, it would seem that, in the rat molar, the sequence of change accompanying eruption and separation of the epithelium from the tooth surface is (1) a slow, gradual proliferation of the mouth epithelium downward behind the epithelial attachment; (2) an equally slow degeneration of the epithelial attachment; (3) a progressive keratinization of the surface of the proliferated mouth epithelium, and (4) a slow separation of the mouth epithelium from the atrophying epithelial attachment, the latter remaining attached to the enamel as the secondary cuticle.

In a way, these changes constitute a process of substitution in which the mouth epithelium replaces the epithelial attachment. Yet it should be understood that the epithelial attachment, in various stages of degeneration, may remain between the mouth epithelium and the surface of the tooth, all three structures, tooth, epithelial attachment and mouth epithelium, being attached and continuous one with the other from the crest of the gingiva to the deepest extremity of the proliferated mouth epithelium.

As separation of the one epithelium from the other takes place, a pocket may, of course, be formed. As has been said, this does not seem to have occurred in this material unless through trauma, the keratinized layer of the mouth epithelium at the crest of the gingiva usually being smoothly continuous with the secondary cuticle, maintaining the same relationships between the tissues as existed at the beginning of eruption. (Figs. 1 and 7.)

GROWTH OF EPITHELIUM ALONG THE ROOT

Again, Gottlieb[1] was the first to point out that when the point of separation of tooth and epithelium approached the enamel-cemental junction, the epithelium had already begun to grow down the surface of the root. It has never been possible to determine definitely the ratio of these changes, principally, if for no other reason, because there is no fixed point from which measurements can be made. Kronfeld and Ullik[14] venture farther than most when they say that separation probably must be reasonably far advanced before growth of the epithelium sets in. Becks,[15] in the light of his newer findings, is satisfied with saying that it occurs when the proliferating mouth epithelium reaches a certain distance from the enamel-cemental junction. Neither can anything more definite be said in the present instance.

In this material, proliferation of the epithelial attachment along the cementum has begun when the proliferating mouth epithelium is still some distance from the enamel-cemental junction. Furthermore, at this time, the potential pocket, that is, the keratinized layer of the proliferated mouth epithelium, is even farther away from the enamel-cemental junction.

An early stage of epithelial proliferation along the root is shown in Figure 7. The base of the proliferated mouth epithelium is at *B*, with the deepest extremity of its keratinized layer terminating at *K*, some distance above the enamel-cemental junction. The epithelial attachment has grown a short distance along the cementum, extending from *T*, the enamel-cemental junction to *T'*. Figure 9, showing a little greater proliferation of epithelium along the cementum (*T* to

14. Kronfeld, Rudolf, and Ullik, R.: Brechen auch bei "wilden Tieren" die Zähne kontinuierlich durch? Ztschr. f. Stomatol., 26:84-102, 1928.

15. Footnote 5, p. 2173.

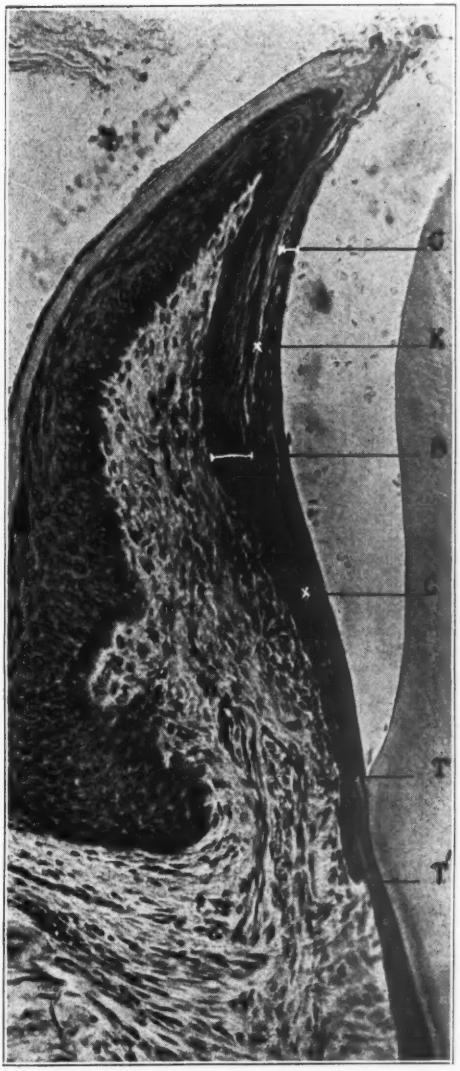

Fig. 9.—Section from adult rat. *C*, epithelial attachment; *K*, deepest point of growth of keratinized layer of proliferating mouth epithelium *B*. The epithelial attachment has grown along the root from *T*, the enamel-cemental junction, to *T'*. No inflammation is present.

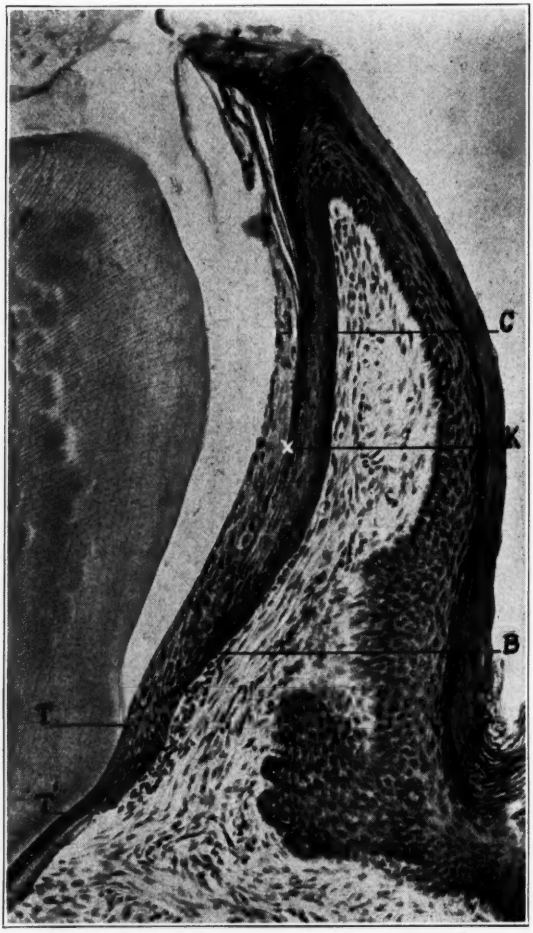

Fig. 10.—Section from 1-year-old rat. *C*, epithelial attachment showing degeneration at this point; *K*, deepest point of growth of keratinized layer of proliferating mouth epithelium which terminates about *B;* growth of epithelial attachment along the root from *T*, the enamel-cemental junction, to *T'*. No inflammation is present here. (Compare text.)

T'), compares favorably with the previous figure, the bottom of the potential pocket (*K*) being still some distance from the enamel-cemental junction (*T*). Variations of this general rule, of course, occur, but seem to be exceptional. In Figure 12, for instance, both the proliferating mouth epithelium and the process of degeneration in the epithelial attachment apparently have reached a point fairly close to the enamel-cemental junction somewhere in the neighborhood of *B*, yet there is no indication of growth of epithelium along the root. In Figure

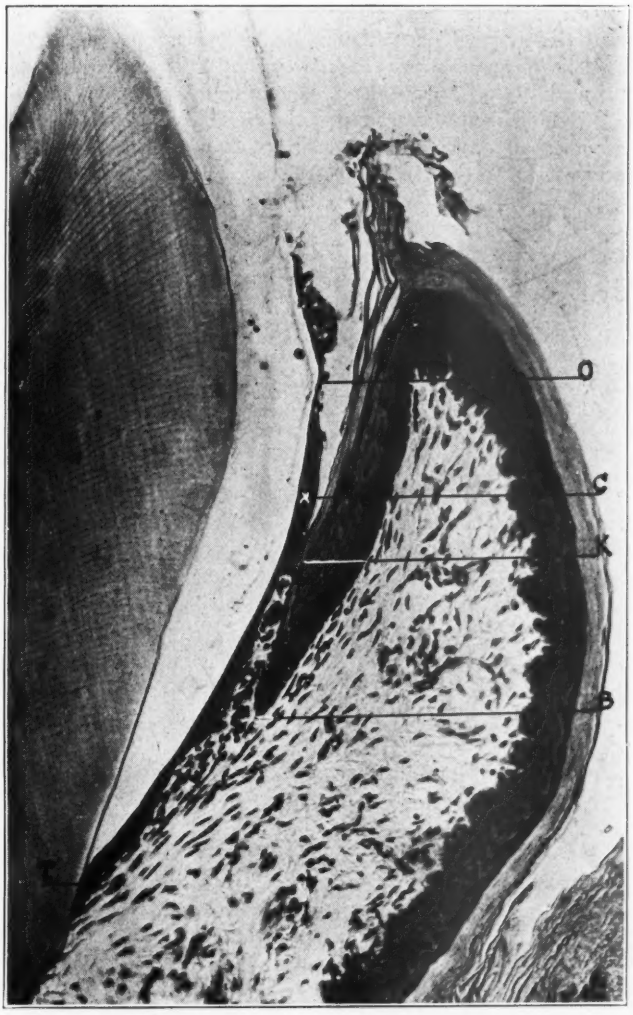

Fig. 11.—Section from 1-year-old rat. The degenerating epithelial attachment *C* has separated from the mouth epithelium, leaving at *O* the primary cuticle. *K*, deepest point of growth of keratinized layer of proliferating mouth epithelium which terminates at *B*; *T*, enamel-cemental junction.

10, the proliferating mouth epithelium has reached a point (*B*) somewhat nearer the enamel-cemental junction *T* than usual, but with only the average amount of growth (*T* to *T'*) along the root having occurred. Figure 17 illustrates a still more exceptional case from a 3-year-old rat. All the teeth, and all the

surfaces of the teeth of this animal presented very similar conditions to those illustrated, all showing almost less change than did the teeth of the 25-day-old rat. (Figs. 4-5.) The epithelial attachment (*C*) shows practically no change, and bears the primary cuticle (*O*) on its surface. It is continuous with the mouth epithelium which is somewhat thickened at *B*. An irregular keratinized band (*K*) passes back into the substance of the latter tissue. Only the thickening of the mouth epithelium indicates any attempt on the part of this tissue to proliferate.

This material further shows that when the proliferating mouth epithelium has reached or passed beyond the enamel-cemental junction, with degeneration of the epithelial attachment a step or two behind it, proliferation of epithelium along the cementum has progressed a considerable distance.

Fig. 12.—Section from 2-year-old rat. *C*, the epithelial attachment, has assumed the appearance of keratinized tissue. *B*, proliferated mouth epithelium, the termination of which cannot be determined; *T*, enamel-cemental junction.

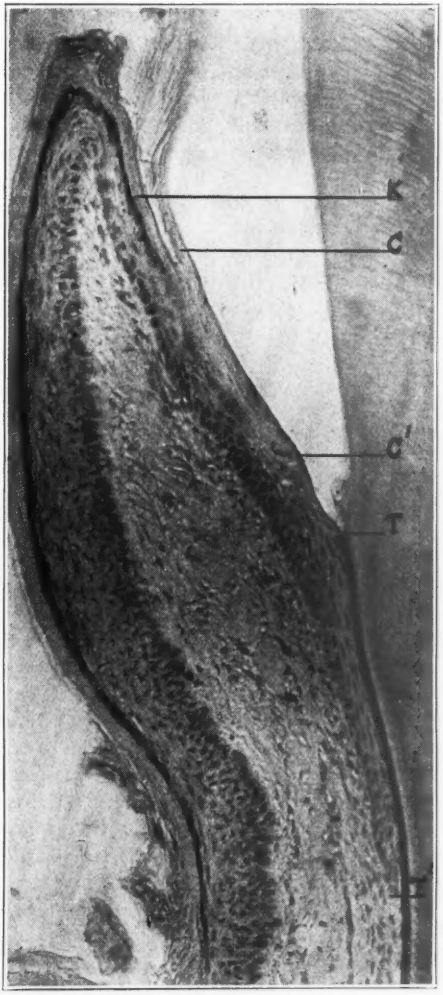

Fig. 13.—Section from 2-year-old rat. *K*, keratinized layer of proliferated mouth epithelium, the termination of which cannot be determined; *C*, epithelial attachment, atrophied to *C'*, and grown along the root from *T*, the enamel-cemental junction, to *T'*. No inflammation is present.

Figures 13, 14 and 16 illustrate this. In Figure 13, the exact point of termination of the mouth epithelium cannot be determined because of its smooth fusion with the epithelial attachment. But the process of atrophy of the latter, and possibly also keratinization of the mouth epithelium, has reached a point (*C'*) a short distance above the enamel-cemental junction (*T*). The epithelial attachment terminates some distance (*T'*) below the latter point. In Figure 14, the mouth

epithelium terminates at *B* a short distance below the enamel-cemental junction, to which point (*C*) the process of atrophy of the epithelial attachment has reached. Growth along the cementum terminates at *T'*. In Figure 16, the mouth epithelium (*B*) has also passed the enamel-cemental junction (*T*), with the proliferated epithelial attachment extending to *T'*. The keratinized layer of the former has arrived at *K*, but complete atrophy of the epithelial attachment has not taken place, cell structure still being discernible to the crest of the gingiva, where this layer becomes continuous with *S*, the secondary cuticle. In Figure 15, the crest of the gingiva (*A*) itself is c'ose to the enamel-cemental junction. A pocket may have existed *in vivo* in this region. The epithelium, as well as the keratinized layer of the mouth epithelium (*K*), terminates at a point on the cementum some distance below the enamel-cemental junction (*T*).

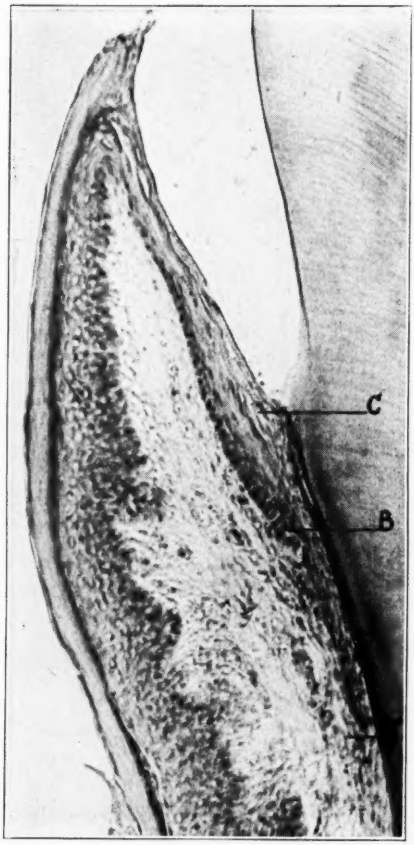

Fig. 14.—Section from 3-year-old rat. The epithelial attachment is atrophied and has the appearance of keratinized tissue down to *C*, the enamel-cemental junction. Proliferating mouth epithelium reaches to *B*. The epithelial attachment has proliferated along the root from *C*, the enamel-cemental junction, to *T'*.

It may be said, then, that, in general, growth of the epithelial attachment along the cementum keeps pace with proliferation of the mouth epithelium, and that when the latter has reached the enamel-cemental junction, the epithelial attachment has already grown some distance along the root. Thus, there is always a relatively thick layer of epithelium between the lowest extremity of the potential pocket or potential line of separation and the connective tissue.

At this time, a discussion of the different theories relative to epithelial proliferation along the cementum will not be entered into. Some view this process as a normal, physiologic one; others, as a pathologic one. As regards the latter, suffice it to say that this material indicates that proliferation of epithelium along the cementum may occur in the entire absence of any visible pathologic process, but that it may also occur in the presence of a localized or a more distant pathologic condition.

Figures 7, 9, 13 and 14 illustrate instances in which, although the epithelium had grown varying distances along the

cementum, not the least indication of a pathologic process could be discovered in and about the teeth. On the other hand, Figures 8, 10, 15 and 16 illustrate instances in which trauma and inflammation existed, either in the immediate region or in adjacent parts. In Figure 8, a slight cellular infiltration is noticeable at *I*, while in Figure 16, at *L*, a foreign body is lodged in the epithelial attachment. In the former, there is some indication that a proliferation of the basal layers of the epithelial attachment had been in progress (*P*), Figure 5 showing a similar condition, due to the lodgment of a foreign body in the epithelium. Figures 10 and 15 illustrate cases in which, although no pathologic process could be observed in the immediate neighborhood, inflammation of some degree existed on adjacent surfaces. For instance, considerable inflammation existed

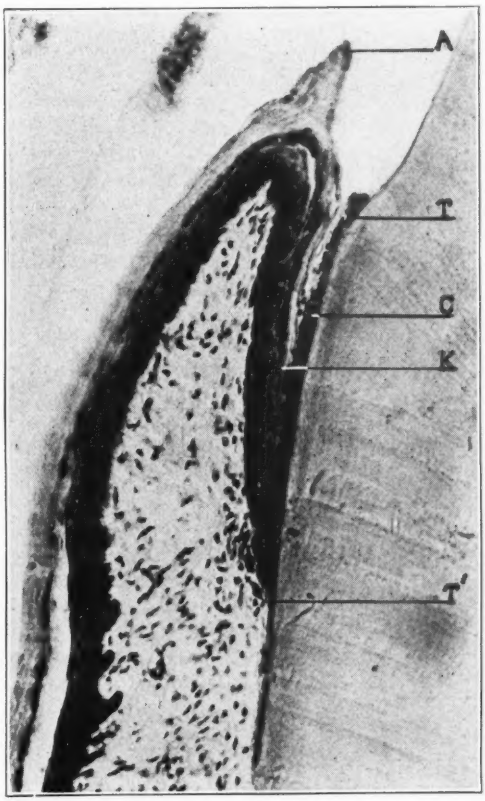

Fig. 15.—Section from 3-year-old rat. There is possibly a pocket from *A*, the crest of gingiva, to about *T*, the enamel-cemental junction. There is growth of the epithelial attachment *C* along the root from *T* to *T'*. *K*, deepest point of growth of keratinized layer of mouth epithelium. No inflammation is present in this area. (Compare text.)

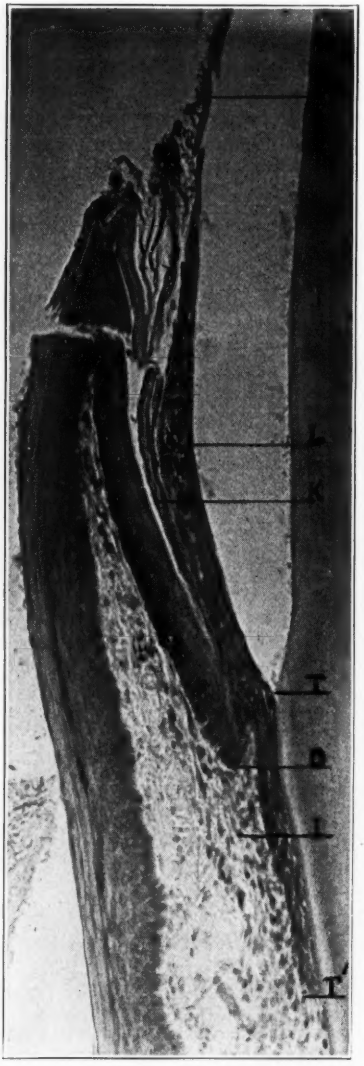

Fig. 16.—Section from 1-year-old rat. *S*, secondary cuticle continuous with degenerating epithelial attachment, in which there is lodged a foreign body at *L*. *K*, deepest point of growth of keratinized layer of proliferating mouth epithelium which terminates at *B*, a short distance below the enamel-cemental junction *T*. The epithelial attachment, only slightly degenerated, has grown along the root from *T*, the enamel-cemental junction, to *T'*. *I*, area of inflammation.

on the interproximal surfaces of the tooth, which Figure 10 illustrates. Figure 18 illustrates the lingual surface of the tooth, from which Figure 15 was taken. The latter shows no pathologic process, while in the former, there is a mild inflammatory reaction of the subepithelial connective tissue, and a heavy calculus deposit (*H*) occupies the pocket. There is no certainty, of course, that abnormalities on one surface of a tooth affect conditions on another; yet they must be taken into consideration.

Normally, a certain ratio seems to exist between all the changes which take place. It was pointed out that in Figure 8, for instance, growth of the mouth epithelium was disproportionate to the proliferation along the root, and that in Figure 16, the same growth was disproportionate to the extent of degeneration of the epithelial attachment. Figure 10 shows conditions similar to those shown in Figure 8.

Such instances tend to give the impression that, rather than injury and inflammation materially influencing epithelial growth along the cementum, they stimulate growth of the mouth epithelium in particular, and frequently growth of the basal layers of the epithelial attachment. In both cases growth may lead to the formation of papilla-like processes, which grow out into the connective tissue in an irregular arrangement. This is in evidence in Figure 18. The mouth epithelium (*B*) is somewhat thickened, showing a tendency toward abnormal papillation. The epithelial attachment (*T* to *T'*) on the root also shows a decided tendency toward papillation (*P*), its irregular arrangement being quite observ-

able when compared with the smooth, regular arrangement of an apparently physiologic proliferation, such as Figure 13 illustrates.

Finally, a word should be said about the arrangement of the tissues on different surfaces of the same tooth. Orban and Köhler[16] pointed out that the rate of eruption of the different surfaces of a tooth need not be the same; that is, that separation of the epithelium from the tooth surface may have proceeded faster on one surface than another, that a great-

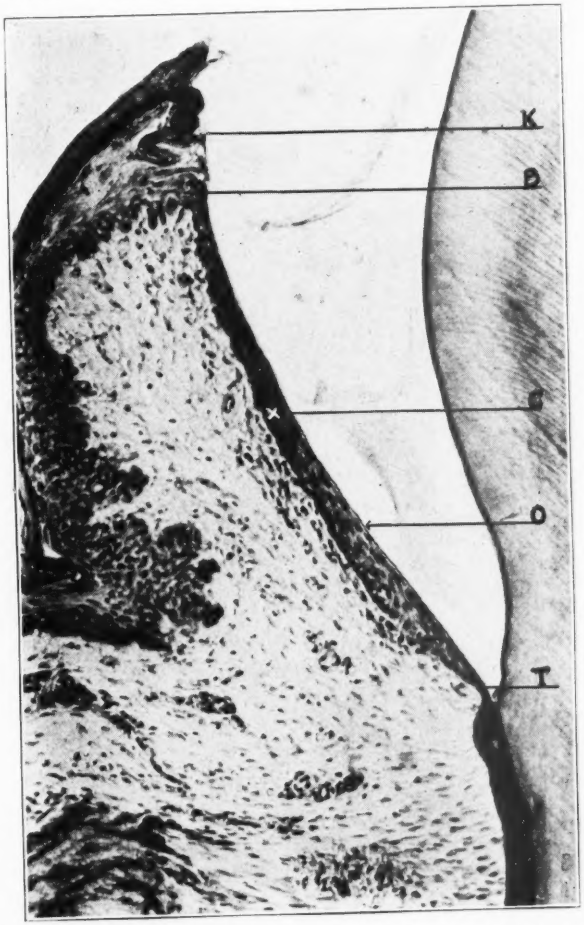

Fig. 17.—Section from 3-year-old rat. (Compare with Figures 4 and 5.) *K*, keratinization of mouth epithelium, which is unusually thick and continuous with epithelium attached at *B*. The epithelial attachment *C* shows no degeneration and terminates at *T*, the enamel-cemental junction. *O*, primary cuticle.

16. Footnote 8, second reference.

er growth of epithelium may occur on one side than another, and so on.

Similar conditions are met with in the rat molar. On one side, the epithelium may terminate at the enamel-cemental junction, for instance; while, on the other, it has passed that point. The mouth epithelium may have proliferated farther, or degeneration of the epithelial attachment may be farther advanced, on one side than the other. In the main, unless trauma or inflammation had influenced conditions, the two surfaces which were studied showed marked similarity.

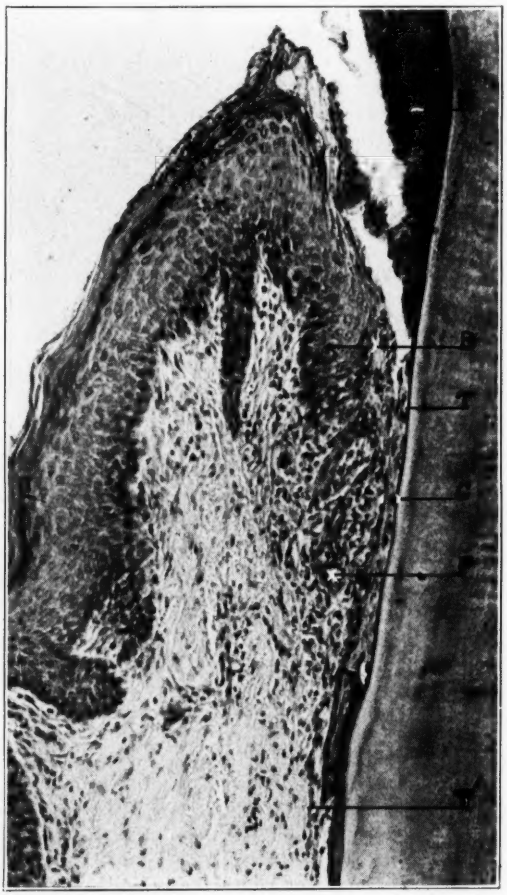

Fig. 18.—Lingual surface of Figure 8. (One-year-old rat.) *H*, calculus; *B*, proliferated and thickened mouth epithelium terminating about on a level with the enamel-cemental junction *T*. There is growth of the epithelial attachment along the root from *T* to *T'*, with an irregular proliferation of its basal layers *P*. Inflammation is present.

COMMENT

It would appear from these findings, and particularly in the light of similar observations made by Becks on human and other animal material, that again our conception of the anatomy of the gingivae must be revised. More than ever does it become a changing structure, not at all like the fixed thing which the older writers described, and still different from the more recent descriptions.

The order of the changes which take place is still open to further observation. Becks sees two possibilities: one, that the epithelial attachment (enamel epithelium), having fulfilled its function, degenerates first, this making it necessary for the mouth epithelium to cover over a potentially open surface; the other, that the mouth epithelium, for some unknown reason, proliferating first, shuts off the nutritive supply of the enamel epithelium, this inducing degeneration and atrophy of that tissue.

As has been pointed out, the latter possibility seems to be the one which prevails in the rat molar. At the same time, it must be recognized that early changes in the epithelial attachment may be so subtle as to be indistinguishable, and that, therefore, in reality the first changes may occur in the latter.

Furthermore, it is true that at the point at which the two epitheliums come together in the beginning stage of eruption an unusually thick layer of epithelium is formed. Now, a sufficient circulation for the outer parts of this epithelial layer may not have developed. The tendency, then, would be for the more distant layers to degenerate, and those layers would be in the enamel epithelium.

Other possibilities are equally difficult to prove. It may be that as the tooth erupts a much less complete union takes place between the mouth epithelium and enamel epithelium than is supposed. A potential break, therefore, would exist in the continuity of the epithelial surface, which it is the function of the mouth epithelium to repair. On the other hand, it may be that masticatory influences stimulate the more vital of the two epitheliums, the mouth epithelium, to proliferate, thus setting in motion the series of changes which have been described.

Further study is necessary in this regard before any conclusions can be drawn.

No attempt has been made here to view the practical significance of these findings, nor to go into the many related features, such as continuous eruption, condition of cementum, changes in the alveolar process, and so forth, which occupy so much attention in the literature. And only a brief reference has been made to the rôle played by pathologic conditions. These are things which require further observation, and which will possibly be dealt with later.

The main desire was to present what now appears to be the normal anatomy of the gingivae as it is depicted in the molar teeth of the rat.

SUMMARY

Subsequently to beginning eruption stages of the molar teeth of the rat, slowly operating changes take place which alter materially the structure of the gingivae as time goes on. These changes, at the present time, have been traced into the third year of adult life of the animal.

1. On atrophy of the ameloblasts, a thin membrane, which may probably be called a "primary cuticle," puts in an appearance. This membrane is probably attached to the enamel, and, in turn, the epithelial attachment, which is the remains of the enamel epithelium, is attached to it.

2. At the same time, other changes are going on, the sequence of which seems to be as follows: (1) proliferation of the mouth epithelium downward behind the epithelial attachment; (2) atrophy of the latter in the process of which it slowly assumes the appearance of keratinized epithelium; (3) keratinization of the surface of the proliferated mouth epithelium; (4) separation of the mouth epithelium from the atrophied epithelial attachment, the line of separation being the keratinized layer of the former.

3. While the proliferating mouth epithelium is still some distance from the enamel-cemental junction, and its keratinized layer still farther away, the epithelial attachment begins to grow down the cementum.

4. This proliferation of the epithelial attachment along the root surface seems to occur in the entire absence of any visible pathologic condition.

5. A certain ratio of change seems to prevail between the different processes, which inflammation seems to disturb.

6. Inflammation may induce a more rapid growth on the part of the mouth epithelium in particular, but apparently causes an irregular, papilla-like growth of the basal layers of the epithelial attachment.

7. In most instances, in this material, no measurable pockets seemed to exist except where they were the result of trauma.

THE LITERATURE

In addition to the references given, the literature contains the following:

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THE ORTHODONTIST AND GENERAL PRACTITIONER FROM THE EDUCATIONAL, PROFESSIONAL AND ECONOMIC POINT OF VIEW*

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THE status of orthodontia in dentistry today and its relation to pedodontia merit special consideration as revealed by current dental literature. Preventive dentistry, pedodontia and orthodontia have rapidly advanced to enlarged fields of endeavor, to greater significance in the cause of public health service. In consequence of this development, a survey of their interrelationship from an educational, a professional and an economic standpoint is apropos and to the interest of the dental and medical professions.

First, in consideration of the profession at large. It is with a sense of pride and the realization of individual responsibility that we recognize the significance of Dr. Gies' report to the Carnegie Foundation. In accordance with the substance of its general conclusions, that "dentistry is an important branch of health service, that the practice of dentistry cannot be made a specialty of the conventional practice of medicine, but should remain a health service of equal recognition with other specialties of medicine," dentistry has been elevated from the vocational training basis to that of a recognized, liberal profession under a cultural standard, its rightful place secure within the realms of university training. This recognition has been attained unreservedly upon the precept that the prime object is to serve the cause of public health in close cooperation with medicine.

Two problems confronting the profession which vitally concern the stability of the standard attained are: (1) the training of the orthodontist in undergraduate and postgraduate curriculums; and (2) the necessity of actual performance in caring for the dental needs of the youth of our country. This involves children's dentistry in the hands of the general practitioner, the development of the specialty pedodontia, and their relation to orthodontia.

EDUCATIONAL STANDPOINT

The status attained by orthodontia is that of a vital, integral part of the profession, the prime object of which is the same as that of dentistry in general, the scope of which is as intricate and broad as the modern biologic concept implies, embracing a study of the various phenomena of the processes of life itself. This branch of the profession cannot longer be regarded as a science and an art set apart as an entity to be studied for its development; rather, it is deemed essential to correlate properly its basic principles with the various subdivisions of the professions involved in the healing art. As a concrete example, the subject

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of occlusion, considered the basis of all dentistry, by proper correlation in its studies, is concerned with the maintenance of function, the restoration of function or the development of the masticatory apparatus "best suited to the functional activities of the organism as a whole."

While orthodontia is recognized as an important subject in the dental curriculum today, the recipient of the D.D.S. degree is not prepared to enter the actual practice of this branch of dentistry to the extent that he is qualified in operative and prosthetic dentistry in particular. The report of the Dental Educational Council of America states explicitly: "The dental graduate should be prepared to begin with adequate safety the practice of dentistry, but experience is essential for his proper development. It does not aim to graduate an expert at the beginning of his career, but rather to so equip him that he may grow through experience to the attainment of this standard of excellence." With increased requirements, from a preliminary high school education and three dental years to two years of liberal arts and four dental years, it is noteworthy that, thus far, the discrepancy in length of training has been utilized to lay a broader foundation upon which to build the superstructure of dental training, a subsequent increase of hours resulting in all subdivisions of the profession to meet the requirements of higher standards of work. Nevertheless, the recognized needs for specialized service still mount to additional training of at least one year of postgraduate work.

In consideration of the existing legal requirements for the practice of orthodontia to any extent and in any manner whatever, based solely on the license to practice dentistry, and in view of the recent agitation to induce special legislation for licensing the practice of orthodontia, which would, in a measure, be the first step to break the integral part which it fulfils so advantageously in the dental curriculum and to divorce it from dentistry, the consensus of opinion of the educators of our schools is deemed of value. To determine the importance attached to orthodontic instruction and the desire of educators regarding revised legislation, the following questionnaire was sent out. Of a total of forty-two colleges of dentistry in the United States, twenty-six replied to the respective questions as follows:

What importance do you attach to instruction pertaining to orthodontia, leading to a D.D.S. degree? What is the principal object of such instruction? Is it to qualify the graduate for the actual treatment of cases in any manner whatever before taking postgraduate work? If so, to what degree?

The unanimous opinion was that the instruction is of major importance and essential in presenting the fundamentals of orthodontia; that it shows the interrelationship of all body tissues. All concur that the practitioner should be trained to institute preventive measures, and 70 per cent include this to mean the treatment of simple cases.

Is it to qualify one to recognize conditions which it is advisable to treat?

Answer: Unanimously, "Yes."

Does the instruction stress the particular responsibility imposed on the general practitioner either to render professional services to children personally or to take pains to see that the child is referred to a person competent to render such services?

Answer: Unanimously, "Yes."

Does the instruction stress the importance of preventive dentistry?

Answer: Unanimously, "Yes," including the supplement, "and in the future the successful dentist will be thinking in terms of children's dentistry."

Does the instruction stress the importance of periodic examinations concerning developmental conditions?

Answer: Unanimously, "Yes," supplemented by "emphatically."

Is the subject of preventive orthodontia given distinct consideration?

Answer: "Yes" (21). "Yes, emphatically" (4). "No, unfortunately, not as yet" (1).

Does the instruction stress the importance of systemic conditions as causative factors in malocclusion?

Answer: "Yes" (23). "Yes, emphatically" (2). "Not extensively" (1).

Does the instruction stress the importance of local conditions as causative factors in malocclusion?

Answer: Unanimously, "Yes."

What length of course do you recommend for postgraduate study in order to qualify for declaring oneself an orthodontist? For such a course, how much time in clinical experience should be required?

Answer: "One year, of which at least half time should be devoted to clinical practice" (12). "Two years, of which eighteen months should be given to clinical practice" (3). "An unfortunate prerequisite is particular aptitude for the specialty, sincerity, five years of general practice and then six months of technic supplemented by collateral reading" (3). "Devote one half time for two years to facilitate treating cases" (2). "Have not considered the question" (2). "Three months' intensive study after three years' practice in general dentistry—one-third time in clinic" (1). "Three years" (1).

Do you consider a special examination by the state board of examiners desirable in granting a license to practice orthodontia to any extent whatever?

Answer: Unanimously, "No."

If not, do you consider a special examination desirable for a license to declare one's self a specialist?

Answer: "No" (16). "No, if the training of the specialist is to emanate from the postgraduate schools of accredited universities" (7). "This should be controlled in some way" (2).

Do you consider a national board of examiners desirable or necessary to classify one's standing before the individual state boards of examiners for the partial or exclusive practice of orthodontia?

Answer: "No" (21). "Might be advisable to have a commission appointed composed of orthodontists to consider the qualifications of those who apply for admission as specialists, either state or national" (2). "Certain abuses appearing to need remedial action have apparently corrected or adjusted themselves. Specialties receive their additions to the ranks from the great mass of general practitioners who, during the years of their practice, have shown an aptitude for the particular subject. This should be encouraged and not hindered" (1). "No, although the national board would be ideal, I fear that it is practically impossible because of the unfortunate sectional prejudices existing, owing to varied technic of diagnosis and treatment. I would suggest a B.S.-D.D.S. degree supplemented by an M.S.O. (Master of Orthodontic Science) from an accredited college" (1).

A review of Abram Hoffman's questionnaire submitted in like manner reveals that the majority answered in the

affirmative, as follows: That the subject of orthodontia should be included in the undergraduate curriculum—that such instruction should include a reasonably complete course in laboratory technic, besides being didactic, and that the student should have an opportunity to develop operative skill.

The conclusions drawn from a study of these questionnaires are as follows:

Orthodontia is an essential part of the dental course. It is biologic in scope and correlated with biologic dentistry, and it serves to broaden the student's views in all branches.

A knowledge of fundamentals lays the proper foundation for a specialized training, which, in the opinion of many, is most advantageously pursued after some years in general practice.

Orthodontia for the undergraduate should embrace a limited amount of technic and clinical training to prepare for appliance assemblage in the treatment of "simple cases" only.

The undergraduate should understand etiology and diagnosis with particular efficiency, since his position is of special responsibility for the recognition and referring of cases, many of which come to his attention first hand.

The courses lay particular importance on preventive dentistry and therefore the successful dentist will soon be thinking in terms of children's dentistry.

Preventive dentistry is identified with children's dentistry, and if it is thoroughly practiced, it involves procedures which may be construed as preventive orthodontia.

There is a consensus of opinion regarding the purpose of the instruction, but its manner of presentation needs revision, for unification and standardization.

Our educators are generally opposed to the separating of orthodontia from dentistry by any licensing board or by any legal means, to set it up as a distinct profession. Some feel that sufficient abuse is in evidence, as exhibited by certain incompetent members, to warrant a national or regional board, the certificate of which would bear witness to the qualifications of those holding it.

The training for specialized practice should emanate from the graduate schools of accredited universities, the majority favoring one year with clinical work as a minimum requirement.

PROFESSIONAL STANDPOINT

Since society is vitally concerned in the use made of knowledge attained by its members, considerations from a professional standpoint are now offered to ascertain: (1) the degree to which orthodontia may be intercepted by pedodontia; (2) the scope of work embraced by pedodontia as related to orthodontia; (3) the professional relations of pedodontists and the general practitioners; (4) the attitude of the profession toward children's work, and (5) the opinion concerning treatment for the development of the deciduous dentition.

To the following questionnaire, replies from forty-six members in the exclusive or partial practice of pedodontia, representing all sections of the country, were as follows:

Do you recognize the break in the continuity of the arches of the deciduous teeth, without follow-up of space maintenance, as a paramount cause of malocclusion?

Answer: "Yes" (36). "A direct cause, the age being an important factor" (6). "No, a minor cause" (4).

Do you feel that your specialty is particularly instrumental in furthering the cause of preventive orthodontia?

Answer: Unanimously, "Yes."

What percentage of children whom you have attended from an early age, do you estimate, require subsequent extensive orthodontic corrections?

Answer: "Five per cent" (9). "Fifteen per cent" (14). "Thirty per cent" (4). "From 50 to 60 per cent" (4). Undetermined (5).

Do you regard the attitude of the average general practitioner as indifferent and his attention lax in rendering proper professional services to children?

Answer "Yes" (26). "Yes, decidedly" (10). "Shows lack of understanding" (6). "No" (4).

What percentage of general practitioners do you estimate consistently refer children from their practice to the pedodontist?

Answer: "One per cent or less" (26). "Five per cent" (11). "Ten per cent" (8). "Thirty per cent" (1).

Do you consider that what might be termed "minor orthodontia" has a definite place in your practice?

Answer: "Yes" (34). "No" (12).

Do you treat to shift anteroposterior relations of the jaws?

Answer: "Yes" (26). "No, refer them to orthodontists" (20).

Do you attempt any general developmental work on the arches by the use of comparatively simple forms of appliances?

Answer: "Yes" (20). "No" (26).

Do you employ space retainers extensively?

Answer: "Yes" (32). "When needed —carefully observed" (14).

Do you place bite planes or onlays to open the bite?

Answer: "Yes" (24). "No" (22).

Do you give instruction regarding dietary measures and nutrition?

Answer: Unanimously "Yes." Some qualify, "limited," also "refer to M.D."

Do you check periodically by roentgenograms the developmental changes and growth rates?

Answer: "Yes, but not regular routine" (20). "Yes, regular routine" (6). "No" (20).

Do you consider developmental spaces before the loss of anterior deciduous teeth particularly desirable?

Answer: Unanimously, "Yes." Some qualified, "desirable."

Do you advocate early expansion of the deciduous arches if the teeth are not separated?

Answer: "Yes" (26). "No, in doubt, and refer to orthodontists" (20).

Have you clinically observed appreciable lateral development of the arches after loss of the anterior deciduous teeth without orthodontic treatment?

Answer: "Yes" (21). "No" (25).

Do you consider vigorous exercise of the jaws an important factor in development as a preventive orthodontic measure?

Answer: "Yes" (40). "No" (6).

The conclusions from statements herein quoted are that:

The prevalence of dental caries and attendant dental disease in children, with subsequent loss of teeth, produces a break in the continuity of the dental arches which is declared a paramount cause of malocclusion.

The prevalence of malocclusion afflicting the youth of our country is estimated from various dental health organizations, activities and research reports, to be from 70 to 90 per cent. The number of children who are under the care of the pedodontist or the dentist who is actively engaged and interested in children's dentistry, and who need subsequent extensive

orthodontic treatment, is hereby estimated as reduced to from 5 to 15 per cent. Careful attention to children's dentistry is thus a significant factor in intercepting malocclusion.

The attitude of the average dental practitioner (there are about 68,000 in the U. S.) is one of indifference toward rendering proper professional care to children. Practically the entire number questioned acknowledge this remissness of their own membership, since only twelve declare their practice limited to pedodontia.

The replies concerning the involvement of such procedures as shifting mesiodistal relations, simple expansion arch application, placing of space retainers, opening the bite and instruction in dietary measures, directing exercise and habits, and instituting roentgenographic check-up on growth and development are indicative of the extensive scope of preventive dentistry for children, as it is practiced today outside the field of the orthodontist.

Preventive or minor orthodontia is interrelating the fields of orthodontia and pedodontia; the result is conducive to close cooperation between the same.

The operator interested in pedodontia gives evidence of study and due regard for those problems concerning early growth and development of the jaws as interrelated with all body tissues. Pedodontia treats of those dental irregularities in the incipient stage, intercepting many cases which are developing aggravated types of malocclusion.

ECONOMIC STANDPOINT

From an *economic* standpoint, it is evident that preventive dentistry, as it promotes the conservation of the teeth, is a consideration of vital interest to the orthodontist and the general practitioner.

The ruthless extraction of teeth, involving the problem of the pulpless tooth, has apparently descended from the "high water mark" to be commensurate with good judgment. Eras of extravagance extort a tremendous price. The principal shortcoming in the dental profession today is the lack of attention to children's work. Truly, education and cooperation are essential. Educationally, it appears that various organizations are doing splendid work to inform the laity. The American Child Health Association, with President Hoover at its head, setting aside "Child Health Day" to proclaim across the continent the slogan, "Perfect health for every boy and girl in the U. S.," presents an urgent reminder to the dentist in every community, of his moral obligation to serve the cause.

Highest ethics demand that the dentist impart knowledge unasked, but proffered for the welfare of the patient. As Dr. Eliot remarked, "Dentistry cannot be a liberal profession unless its membership devote time to instruction in office practice." Yet it is estimated that the dentist devotes five minutes per hour to instruction. Practically all of his time is consumed in reparative work and little is left for instituting preventive measures. The resolution adopted by the American Society of Orthodontists and the Massachusetts Dental Hygiene Council, urging that all dentists cooperate in the prevention of caries by giving due attention to initial developmental defects of the enamel surfaces, is a measure which strongly appeals, for the conservation of the deciduous as well as of the permanent teeth. Many deciduous teeth are being extracted and very little check-up concerning subsequent space maintenance is being made, with the result that a pronounced contributing factor continues to increase the prevalence of malocclusion.

The degree to which malocclusion can be intercepted by thorough, painstaking dentistry for children, in the opinion of many educators, orthodontists and investigators of the question, is decidedly perceptible.

Frederick B. Noyes has said: "I am sure that three-fourths of the cases of malocclusion which I have had under treatment could have been prevented by the general practitioner."

Arthur D. Black has said: "An extended experience, with carefully kept records, shows the number of cases of severe malocclusion to be comparatively small, if there is good care of the mouth during early childhood."

Walter T. McFall, of the Department of Health, Macon, Ga., who has examined 50,000 children and made mouth corrections in more than 7,000, excluding orthodontic correction, says: "I think that one of the most frequent and fruitful causes of malocclusion for future periodontal disease in adult life comes from too early loss of deciduous teeth without space retainers . . . . I have observed that of children having the first or second deciduous molars extracted on one side, both sides or in the jaws, from 3 to 8 years of age, at least 75 per cent need space retainers, as well as orthodontic treatment because of these early extractions. Of the children from 8 to 12 years of age having the above mentioned deciduous extractions, about 10 per cent need space retainers and orthodontic treatment. As regards those children with teeth retained in a healthy, restored, comfortable and usable condition, until time for normal replacement by succeeding permanent teeth, I have found that about 17 per cent from 3 to 8 years of age also need orthodontic treatment because of other etiologic factors."

R. C. Willett, who is doing such splendid work in advancing the technic and demonstrating the importance of intercepting malocclusion, says: "The importance of supervising the normal shedding of the deciduous teeth and the eruption of the bicuspids cannot be overestimated."

Abram Hoffman says: "If the majority of dentists had a deeper interest in, and a keener appreciation of, the deciduous dentition, and made an earnest effort to preserve these precious teeth to their full term, one intelligent family dentist could do more to ward off malocclusion, through preventive measures, than a dozen orthodontists can remedy by corrective measures after the malocclusion is once established."

Charles R. Baker says: "It is far more important to prevent than to treat malocclusion, and the prevention of malocclusion necessitates an early recognition of abnormal development."

B. O. Sippy says: "I have made a study of the effects of the early loss of teeth in developing dentition and in adult dentition, and I have no hesitation in saying that of all etiologic factors involved in malocclusion, none is so important in point of frequency of occurrence or more far-reaching in its influence in disturbing occlusion and the normal form and functions of the face and jaws than the early loss of teeth."

It is evident, therefore, from an economic point of view, that if malocclusion can be intercepted and so reduced from a prevalence of from 70 to 90 per cent to approximately 17 per cent, as the foregoing data, corroborated by individual statements, would indicate, under the existing status, in which 80 per cent of the population cannot afford orthodontic services and less than 1 per cent are receiving orthodontic treatment, and in which the educational institutions are

lacking in facilities to provide the profession with adequate special training, the economic importance of pedodontia, to promote the public health and happiness, is outstanding.

In the light of the foregoing considerations, a frank statement of existing conditions with constructive suggestions for their improvement is in order.

With the advancement attained by the dental profession to render adequate service in the interests of public health, and the advancement made by the laity as an awakened public demanding the type of service to which it is entitled, the time is past when a haphazard, cursory examination of the child's mouth, precipitated by "tooth-ache," will suffice as professing to give dental attention to children.

The time is past when the moral obligation of the successful dentist may continue to be negative. Actual performance is necessary and individual responsibility must be centered in the respective fields of endeavor.

Preventive dentistry, as it pertains to pedodontia, now involves an extensive field requiring study and attention for its practice. It invites much needed research for its advancement.

Whether increase or decrease in the degree of specialization for rendering professional services should be encouraged is a moot question. The inexorable laws of human conduct seem to prove that one will inevitably develop and do well in that branch of service for which he develops an aptitude and in which he possesses an innate interest.

The vast majority of the rank and file of the dental profession have an innate dislike for children's work. They are temperamentally unsuited for the work. A comparative lack of understanding on the part of the dentist and a lack of training in pedodontia suggest the need of a definite course in pedodontia, the absence of which is a present weakness in the undergraduate curriculums. Ignorance on the part of the patient is rapidly disappearing in the face of organized public health propaganda. The value of the work can be "sold"; the natural dislike for the work remains the "bug-bear."

The crux of the situation lies in the dearth of pedodontists. This specialty should be developed rapidly. The announcement of those members who would gladly limit themselves to this specialty should be welcomed and sponsored by liberal support of members of the profession in every community who do not care to do children's work with the thoroughness that modern conditions rightfully demand.

It is not suggested in any case to divert the children of individual practices to other doors provided the dentist will give satisfactory service himself. Such service in conjunction with adult practice might best be rendered after a brief course of study presenting the ease and comparative simplicity of efficient dentistry for children, when under a properly organized procedure. Then by institution of "the children's hour" or "children's day," to give this phase of practice a separate berth, with some slight change to make appropriate the surroundings and atmosphere of environment, a pleasing effect is produced for operator and patient alike.

The development of such specialization on broad foundations of education, training and experience, in close cooperation with orthodontia and pediatrics, should prove to be a natural educational development from the simpler to the complex problems of children's dentistry, of which orthodontia is a branch. Cooperation is particularly fostered through advice sought by the pedodontist

from the orthodontist, and through this activity arises the opportunity for potential orthodontists to emerge from the rank and file of dentistry, to find themselves among the most capable orthodontists of the years to come.

The rapid advances being made in the orthodontic field, based upon the modern biologic concept, through research, is placing this specialty nearer the field of specialized medicine. The practical application of fundamental principles, commonly understood, is intimately related to pedodontia, to prevent or intercept malocclusion during stages of incipiency. The fields are already overlapping, and pedodontia may be expected to embrace minor orthodontia to a greater degree, concurrently with its own development.

The actual segregation of "simpler cases" proves indeterminable, since factors of intrinsic importance, involving obscure etiology, may be dormant in the complex organism as a whole. The aims of undergraduate orthodontic instruction, in this respect, must necessarily fall short of their mark, since they stress the importance of a better understanding by the graduate than that possessed by the experienced orthodontist, of the etiology, the diagnosis and the ability to recognize conditions needing orthodontic treatment for the purpose of reference to one with the ability to treat the condition; also, the aims to make one capable of treating the "simpler cases" when the most experienced orthodontists sometimes misjudge the "simpler case," must in a measure fail.

The situation would thus lead to "Let your conscience be your guide" as to the ability to treat successfully cases undertaken. With the extensive development of children's dentistry in the hands of those members of the profession who are genuinely interested in the work, the production of capable orthodontists emerging from the rank and file will be the result of a graduated series of steps in education and experience in the treatment of difficult cases. This condition would seem a decided improvement over the present situation, in which many applicants for orthodontic instruction have previously given little thought or attention to children's work. This does not imply that postgraduate work shall not be deemed essential for preparation in the respective fields; nor does it imply that every pedodontist should aspire to orthodontia, nor that pedodontia is any less noble and worthy a branch of children's dentistry.

It is not intended to present the various operative procedures or to discuss the relative merits of remedial agencies employed in pedodontia as it is related to orthodontia. I wish to point out a few outstanding conditions intimately affecting these fields of endeavor in the light of recent biologic investigations.

Concerning the importance of the deciduous dentitions: It is a well-established biologic law that form and function are interdependent. The pedodontist, being particularly concerned in preventive measures, is most influential in overcoming the etiologic conditions contributing to malocclusion which are of extrinsic origin or of environmental inception. Normal function is contributory to normal form for the individual. The conservation of the deciduous teeth and the use of them during the full term intended for retention are vital factors in development. The aforesaid data by Dr. McFall are significant. The time of loss of the deciduous teeth (particularly the deciduous molars) decidedly affects the degree to which their loss may be

contributory to malocclusion. Concerning use, vigorous mastication is conceded to be the most important, yet a neglected, phase of preventive orthodontia and of dentistry in children 6 years of age and under. The nourishment of an organ depends on the activity of the protoplasm of which it is made up. Between the ages of 2 and 3 years, children should be taught to chew coarse foods thoroughly, the daily menu being planned so that some vigorous trituration of food is required. In addition, the daily practice of biting on soft vellum rubber, or the use of biting pads made from inner tubing and covering the entire occlusal surface of the teeth, has been found very beneficial in providing stimulation to produce developmental spaces of the arches previous to 5 years of age.

Children's dentistry, embracing orthodontia and pedodontia, is a study of growth and development. Study of the process and laws of development is necessary to judge intelligently what may be the satisfactory developmental condition of a child's mouth during successive periods of observation.

An essential consideration in development, as it affects the establishment of occlusion in the permanent teeth, is the length of time consumed in the entire process from the beginning of the loss of the deciduous teeth to the complete eruption of the permanent teeth. Malocclusion is more prevalent, with increase of time consumed by the exchange of dentures. The prevalence of excessive overbite as well as guidance in the interdigitation of cusp relationship during the exchange of dentures is herein seriously affected.

It should be remembered that the physiologic and not the chronologic age is of prime importance. Also, as explained by Milo Hellman,[1] "Development is not a uniform and continuous process. It is limited by spatial and temporal barriers. Not only do some structures grow faster than others in the course of development, but also the same structure speeds up and slows down the rate at which it grows at different periods of life. These accelerations and retardations have a different effect on different individuals, on different structures of the same individual and even on different parts of the same structure."

Dr. Hellman's research[2] also reveals that "the process of erupting and shedding is a phenomenon, the nature of which assumes an aspect as revealed by various processes connected with life. A certain tooth will erupt, the age depending on hereditary tendencies, environmental conditions, other known and unknown factors. The eruption will, however, indicate a definite stage in the development of that dentition."

The check-up, periodically, by roentgenograms will decidedly aid in determining the developmental changes and growth rates. The taking of casts, periodically, is also suggested as providing invaluable data to corroborate concurrently, or shed light on variations from the findings of such research as that which is being conducted by Samuel J. Lewis and Ira Lehman on development of the deciduous arches as related to subsequent development.

Until much more knowledge is available concerning the advisability of early expansion of the deciduous arches, it would seem best to attempt to gain development through such measures as nu-

1. Hellman, Milo: Process of Dentition and Its Effect on Occlusion, Dent. Cosmos, 65:1329 (Dec.) 1923.

2. Hellman, Milo: Face and Teeth of Man, J. Dent. Res., April, 1929.

trition and exercise before resorting to the use of appliances, the simplest of which, it is felt, may to some degree interfere with the natural developmental forces. Increased knowledge concerning nutrition, resulting from recent research, promises to be the most effective means in the cause of prevention. Close cooperation with the pediatrician is highly desirable, but, in many instances, when such reference is not permissible, the dentist may give helpful advice as to the form of diet, and, to a large extent, properly direct essential conditions by utilizing the various courses of instruction now offered, such as that delivered by Sherman L. Davis on "Nutrition and Food Values."

A study of systemic conditions as causative factors in malocclusion leads to the conclusion that the development of dentition is a reflection of general skeletal development as concerns both normal and abnormal tendencies. We would naturally expect that periods of acceleration and retardation would be registered concurrently in the developing dentures and the developing osseous structures in general. Recent research, such as that presented by Clinton C. Howard,[3] in advocating carpal roentgenograms as a guiding influence in diagnosis for the proper time to induce stimulation by appliances, seems to confirm this, and it is considered ineffective to place appliances during a retarded period of skeletal growth. In the light of Dr. Hellman's conclusions, in which he says that children of exceedingly accelerated growth are retarded in their dentition, while children of exceedingly retarded growth are accelerated in their dentition, we are lead to the inference that excessive demands on the energy required for growth in general may reduce that available for the process of dentition. Therefore, it seems to be an unsettled question whether appliances should be employed to produce stimulation during an accelerated or retarded period of development, as indicated by osseous structures in general.

A significant point in question is presented by Professor Boas,[4] who has found that when children are retarded in height up to the twelfth year, they remain permanently short in stature. Dr. Hellman has called attention to the fact that it is questionable whether it is possible to make up during a short period of accelerated growth the loss caused by an extended period of retardation.

Prior to the age of 6 years, there occurs an acceleration of the lateral growth of the jaws. In some cases, there is a prolonged retardation with failure of developmental spaces to appear as late as from 6 to 7 years of age. Having given Nature a chance for lateral development to continue for a considerable time, if development is apparently retarded, preceding the loss of the anterior deciduous teeth, I consider it good policy to apply simple expansion arches, delicately constructed, for inducing stimulation by mechanical means. The following deductions by Frederick L. Stanton[5] concur with this view and meet with the approval of a large percentage of orthodontists of today. Dr. Stanton says, "In the cases observed at 5 years, in which there is not room between the temporary cuspids for four permanent incisors, I know of no good evidence that the dental arch will grow, unaided, in width to contain the perma-

3. Howard, C. C.: Physiologic Progress of the Bone Centers, Etc. Internat. J. Orthodon., 14:948 (Nov.), 1041 (Dec.) 1928.

4. Boas, Franz: Statistics of Growth, Rep. U. S. Comm. Ed., 1914.

5. Stanton, F. L.: Engineering in Orthodontic Diagnosis, J. A. D. A., 15:825 (May) 1928.

nent incisors in normal occlusion . . . we deduct that malocclusion is basically a failure of the palate to widen sufficiently in the region of the temporary molars and a failure of the premaxilla to grow for the alinement normally of the incisors." Dr. Stanton has determined by precise orthographic mapping instruments that the combined width of the lower deciduous molars and cuspids about equal the space required for the four permanent incisors. "With dividers, measure the combined width of the lower deciduous molars and cuspids. Measure the distance between the mesial contacts of the deciduous cuspids. Compare the first measurement with the second. The difference will be the required expansion. If the deciduous arches are lingually and mesiodistally correct, the same expansion should be made in the upper arch."

CONCLUSION

It is hoped that the importance of children's dentistry may be fully comprehended for the advancement of dentistry, the prime object of which is the promotion of public health. In consideration of the rôle that prevention plays as the watchword of the hour in both the medical and the dental profession, and since statistics show that there is malocclusion in from 70 to 90 per cent of all children examined in our public schools, and that the prevalence of this abnormality, affecting the youth of our country, is second only to caries and dental disease, the advantageous position occupied by the general practitioner, in respect to his opportunity for instituting preventive measures, is astounding.

When we consider that a large percentage of potentially severe types of malocclusion might be intercepted by the performance of painstaking work for children, the economic importance of pedodontia in promoting public health and happiness fairly staggers the imagination. When we consider that millions of children might go through life with a fair degree of regularity of the teeth, presenting a practical functional occlusion and healthy investing tissues, instead of the distorted, broken, malalined arches inviting early periodontal lesions and subsequent early loss of teeth, no estimate, from a monetary standpoint, can evaluate the blessing to humanity.

It cannot be expected that even a fair percentage of the vast number of children needing certain treatment embracing such a variety of remedial agencies can or should be directed to the specialist in orthodontia. Obviously, it is desirable that increased numbers of specialists in orthodontia shall join the field, and that as many children come under their care, from an early age, as they can properly care for. Nevertheless, the proportion of children for whom they can care is small, and the only hope of stemming the tide of malocclusion is by intercepting it through preventive measures, with the enlistment of all members of the profession who will take an active, conscientious interest in the cause, or freely refer their patients to specialists, in order that this great work may take its rightful place and be employed for the benefit of mankind.

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ADAMANTINOMA*

By RUDOLF KRONFELD, M.D., Chicago, Ill.

AMONG the different kinds of epithelial tumors which are found in the oral cavity and in the jaws, the adamantinoma is particularly interesting from the standpoint of dental histology. This growth bears a close relationship to a developing tooth and can be explained as a pathologic overgrowth of the dental anlage. Clinically, two main types are found: solid adamantinoma and cystic adamantinoma, the latter also called multilocular cystoma (multilocular cyst).

The solid adamantinoma is a soft, slowly growing tumor of the jaw. It is more often found in the mandible than in the maxilla, and it appears to occur more frequently in young people than in older ones. An adamantinoma is a benign tumor, that is, it does not grow by infiltration or by destruction of the surrounding tissues but merely by expansion. It is well encapsulated and does not metastasize. After operations, recurrence of an adamantinoma has commonly been observed, because complete removal is sometimes rather difficult, and the remaining parts continue their growth.

The cystic adamantinoma (multilocular cystoma) develops from the solid adamantinoma by a cystic degeneration of the epithelial portion of this tumor. Because of this fact, epithelial cysts and bubbles are formed which, for the most part, are found in the body of the mandible. By the pressure of their growth, they cause resorption of the surrounding bone. Originally, there are many separate cysts present, and the tumor therefore shows an uneven and lobulated contour. As the cysts grow, the septums become thinned, finally breaking down and forming one large cyst. Sometimes, the body of the mandible becomes almost entirely resorbed by the cysts.[1]

The adamantinoma is a rather rare tumor. There has been a tendency to call all areas of inflammatory epithelial proliferation adamantinomas, such as the epithelium in apical granulomas. Under such circumstances, the diagnosis of adamantinoma has, of course, been more frequently made. But this procedure is certainly wrong. As we shall see later, the adamantinoma is a growth of a characteristic histologic structure, developing independently of inflammation or other external agents; at least, no true relationship between these two has ever been described. Rather, we must consider the adamantinoma as an evidence of a congenital and an inherent tendency to pathologic growth and abundant tissue formation, which is revealed in these special cases by a pathologic overproduction of tooth forming tissue.

*Read before the Chicago Branch of the International Association of Dental Research, Chicago, Ill., Dec. 16, 1929.

*From the Research Department of the Chicago College of Dental Surgery, Dental Department of Loyola University.

1. Waldron, C. W., in Bunting, R. W.: Oral Surgery, Philadelphia: Lea & Febiger, 1929, p. 467.

Thus, we must emphasize the fact that an adamantinoma seldom occurs. Krompecher[2] reports five cases. Siegmund[3] describes twelve cases collected in the last few years in all Germany. Simmons[4] reports twelve cases, with clinical, histologic and roentgen-ray histories. He emphasizes the difficulty of operative treatment, as the adamantinoma has a marked tendency to local recurrence. He tells of a case in which an adamantinoma metastasized in the glands of the neck

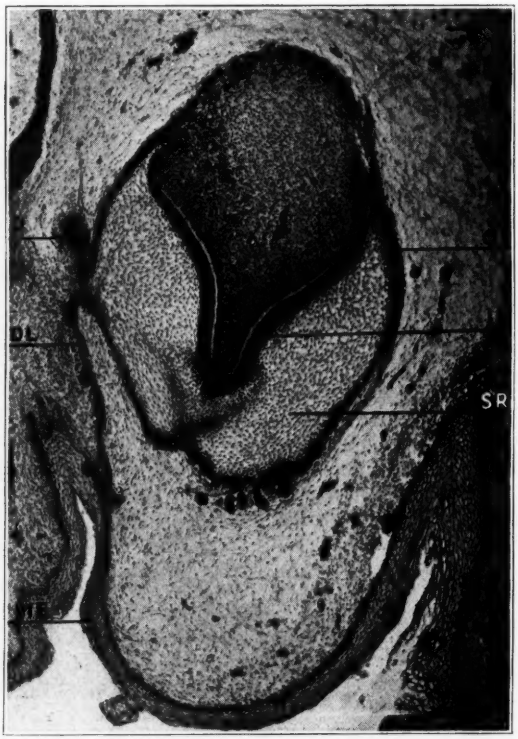

Fig. 1.—Section from human embryo, total length 105 mm., sectioned labiolingually, in the area of the upper first deciduous molar. *ME,* mouth epithelium. *DL,* dental lamina. *P,* germ of the first bicuspid, consisting of a solid epithelial bud. The germ of the deciduous molar consists of inner enamel epithelium. *IE,* outer enamel epithelium *OE,* and *SR,* layer of stellate reticulum between these two. (Compare Orban: Dental Histology and Embryology, Ed. 2, 1929.)

2. Krompecher: Zur Histogenese and Morphologie der Adamantinome, Beitr. z. path. Anat., u. z. Allg. Path., Vol. 64, 1928.

3. Siegmund: Pathologische Histologie, Fortschr. d. Zahnheilk., Vol. 5, No. 4, 1929; Demonstration zur pathologischen Histologie der Adamantinome Paradentium, I, 1, 1929.

4. Simmons, C. C.: Adamantinoma, Ann. Surg., 88: 693-704 (Oct.) 1928.

and in the lungs. In this case, a malignant epithelial tumor evidently had developed from an adamantinoma of long standing.

A further important fact is that the diagnosis of adamantinoma is still more difficult because of the different forms in which it appears. All types between a small soft solid tumor and a large conglomerate of cysts can be found, and only an exact histologic examination of a considerable, well-fixed portion of tissue can verify the clinical diagnosis.

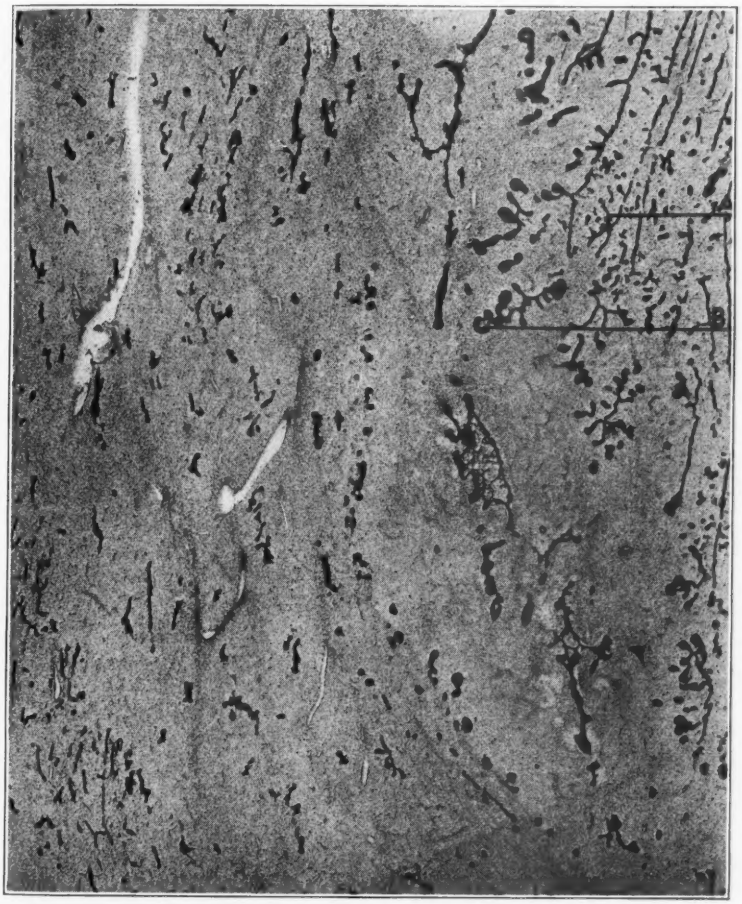

Fig. 2.—Section from soft solid adamantinoma corresponding to the earliest stages of tooth development; solid cords and strands of epithelium (*A*) in a homogeneous stroma of connective tissue. Beginning differentiation of the epithelium is seen in a few places (*B*). (×18.)

Histologically, the solid adamantinoma consists of soft stroma of connective tissue

Fig. 3.—Surface of the adamantinoma shown in Figure 2. The tumor is covered with squamous epithelium. At *A* and *B*, this epithelium is connected with epithelial strands running into the tumor. *C*, terminal swellings branching off from the epithelial strand. *V*, blood vessel in the stroma. (×30.)

containing numerous strands and cords of epithelium. Calcification sometimes is found, but never true enamel or other hard dental substances. As cystic degeneration takes place in the epithelial structures, this solid type gradually changes into a cystic adamantinoma. The cysts are lined with epithelium and filled with clear mucous liquid, sometimes containing crystals of cholesterin.

Concerning the origin of the adamantinoma, there have been various opinions expressed. Some authors relate the adamantinoma to the epithelial rests of the periodontal membrane (epithelial rests of Malassez) or to the epithelial sheath of Hertwig. Others have called special attention to the fact that, in most cases, there is a connection of the tumor with the epithelium of the mouth. Krompecher discusses the question as to whether this tumor is formed from the dental anlage or from the epithelium of the mouth. He emphasizes especially the relation of the adamantinoma to the epithelium of the mouth, and classifies it as a basalioma (tumor of the basal cells of the mouth epithelium). Siegmund expresses the opinion that one cannot establish definitely whether an adamantinoma develops from the epithelium of the mouth, a tooth germ, epithelial rests or the dental lamina.

I do not consider this very essential. The adamantinoma corresponds histologically to a very early stage of tooth development. In this stage, the tooth germ is in very close connection with the epithelium of the mouth through the medium of the dental lamina. A pathologic overgrowth corresponding to this stage of de-

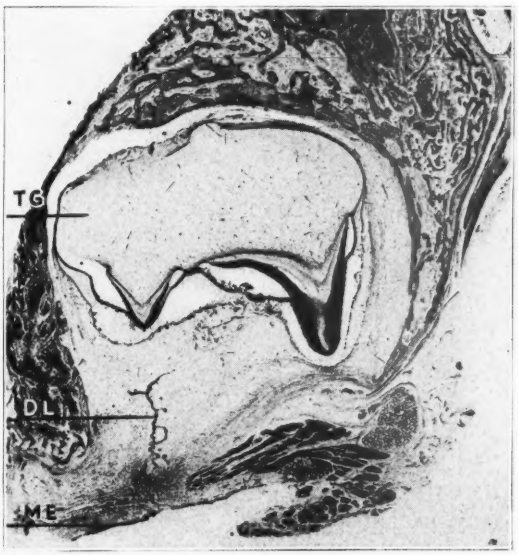

Fig. 4.—Labiolingual section through the upper first permanent molar of a child, aged 6 months. *TG*, tooth germ. *DL*, dental lamina, running from the germ to the mouth epithelium, *ME*. (×7.)

Fig. 3.—Surface of the adamantinoma shown in Figure 2. The tumor is covered with squamous epithelium. At *A* and *B*, this epithelium is connected with epithelial strands running into the tumor. *C*, terminal swellings branching off from the epithelial strand. *V*, blood vessel in the stroma. (×30.)

velopment will, of course, show a similar connection with the covering mouth epithelium from which the normal tooth germ develops.

In studying adamantinoma, we find that, in almost every form, it has a perfect analogy to some early stage of normal tooth development. In the beginning, the adamantinoma imitates the tooth formation to such an extent that we can consider it a real neoplasm of the dental anlage. Just as in an adenoma, a benign epithelial tumor originating from a gland, the structure of the original gland can be easily recognized, so in the same manner, the adamantinoma shows its origin from the dental anlage; but, as is characteristic of pathologic growth, the relation between epithelium and connective tissue and the structure of the supporting

Fig. 5.—Higher magnification of tooth germ and dental lamina from Figure 4. *G*, germ of the second permanent molar. *DL'*, dental lamina running up to the germ of the first permanent molar. *DL''*, dental lamina running down toward the mouth epithelium. *ES*, epithelial shoots of the dental lamina, some of them apparently isolated from the lamina (*ES'*). *FC*, fibrous connective tissue. (×80.)

connective tissue itself is disturbed. Also, the "function" of the normal tooth germ, which is the formation of hard substances, is diverted, since a real adamantinoma never forms enamel. The connection of the epithelial structures of the adamantinoma with the epithelium of the mouth can be explained by the origin of the teeth from this epithelium.

Before I enter into the histologic description of adamantinoma, I wish to give a short outline of normal tooth development as far as it is necessary for the understanding of the histology of these tumors. At the time that the embryo measures from 11 to 13 mm., the mouth epithelium begins to thicken at certain places. Later on, the thickened epithelium remains at these places in its original position, while the surrounding connective tissue grows. In this way, the distance between the tooth germ and the epithe-

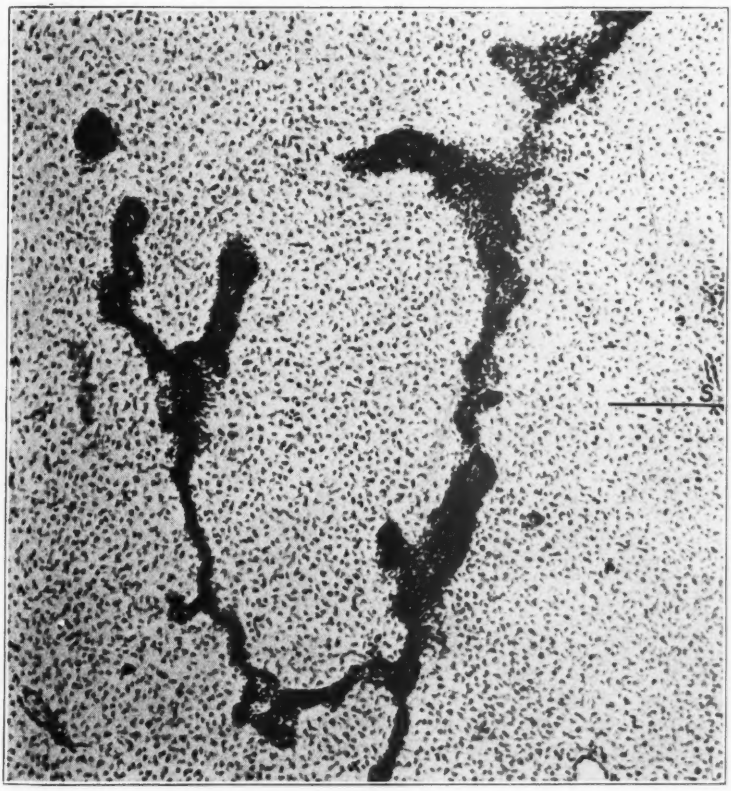

Fig. 6.—Higher magnification of an epithelial strand of the adamantinoma shown in Figures 2 and 3. The structures resemble dental lamina and tooth germ. *S*, connective tissue stroma of embryonic type. (×80.)

lium of the surface increases, and thus the dental lamina is formed and becomes of greater length.

solid mass of slightly differentiated epithelial cells. Later on, in the center of this epithelial bud, the cells become sep-

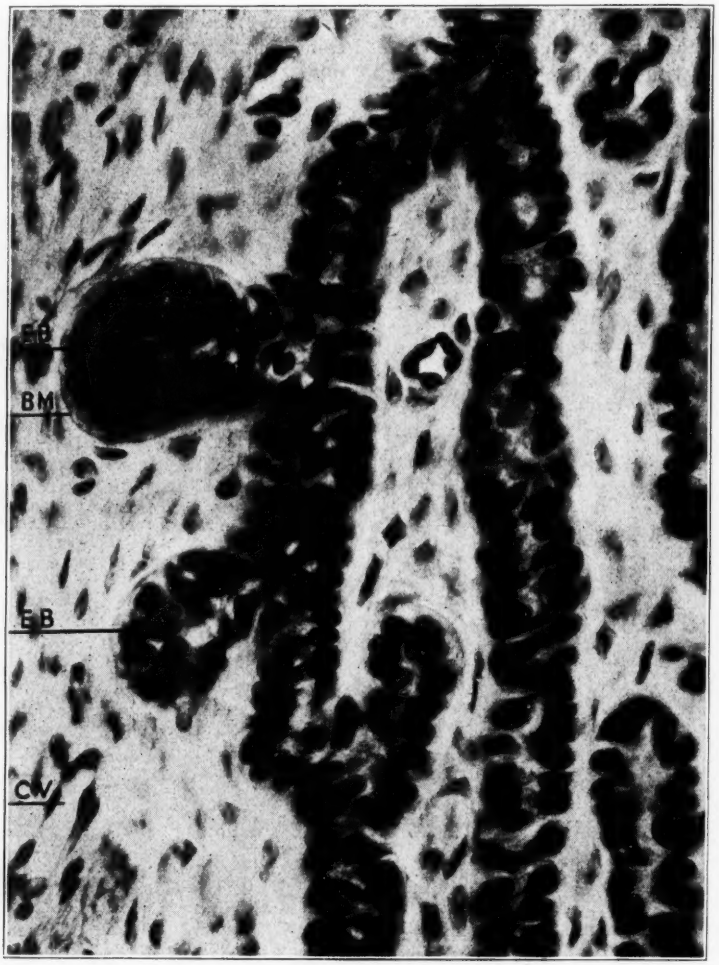

Fig. 7.—Glandlike epithelial strands from the adamantinoma shown in Figures 2 and 3. *EB*, epithelial buds, surrounded by a basal membrane, *BM*. *CV*, capillary vessel in the stroma. (×600.)

As the development proceeds, the tooth germ itself grows and undergoes changes. Originally, the tooth germ consists of a

arated. Small spaces between the cells are formed with fine protoplasmic fibers extending between the neighboring cells.

This tissue is called stellate reticulum. The tooth germ at this stage has about the shape of a bell. The inside is filled with mesodermic tissue, later forming pulp and dentin. The inner epithelial layer changes into high cylindrical cells, the ganoblasts. The outer layer forms the outer enamel epithelium, and the space between these two layers is occupied by the stellate reticulum. The epithelial cells are separated from the surrounding connective tissue by a basal membrane (*membrana limitans*).[5]

Up to this point, all the structures of the developing tooth can be recognized in the adamantinoma. From here on, the development of the adamantinoma shows a very marked deviation from that of

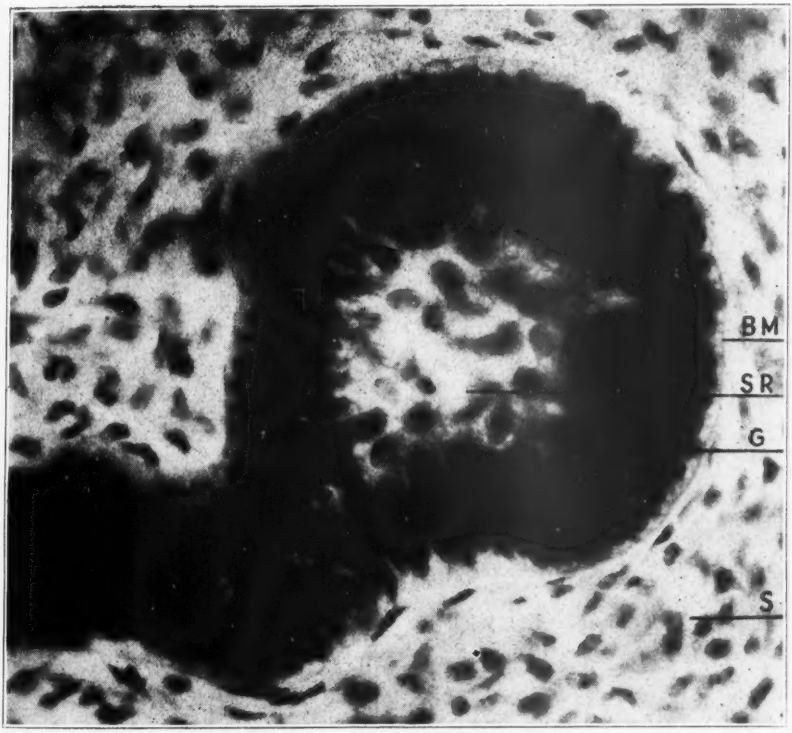

Fig. 8.—High magnification of one of the terminal swellings on the end of the epithelial strands in the adamantinoma (Fig. 2, *B*, and Fig. 3, *C*). The epithelium is differentiated into cylindrical cells similar to ganoblasts (*G*) and into a central loose network of starlike cells (stellate reticulum, *SR*). *BM*, basal membrane. *S*, stroma consisting of connective tissue cells of embryonic character. (×600.)

5. Orban, Balint: Dental Histology and Embryology, Ed. 2, Philadelphia: P. Blakiston's Son and Company, 1929; Growth and Movement of Tooth Germs and Teeth, J.A.D.A., 15:1004 (June) 1928.

the normal tooth germ. The next stage in the development of a tooth germ is the formation of dentin and immediately thereafter of enamel. This stage is never found in an adamantinoma. It seems that, for the formation of the enamel, specialized mesodermic cells are necessary, for among dental tumors, we find enamel dentin formations only in the odontoma. Instead of the formation of hard substance, we find, in the adamantinoma, degenerative changes, such as the formation of cysts by progressive destruction of the stellate reticulum.

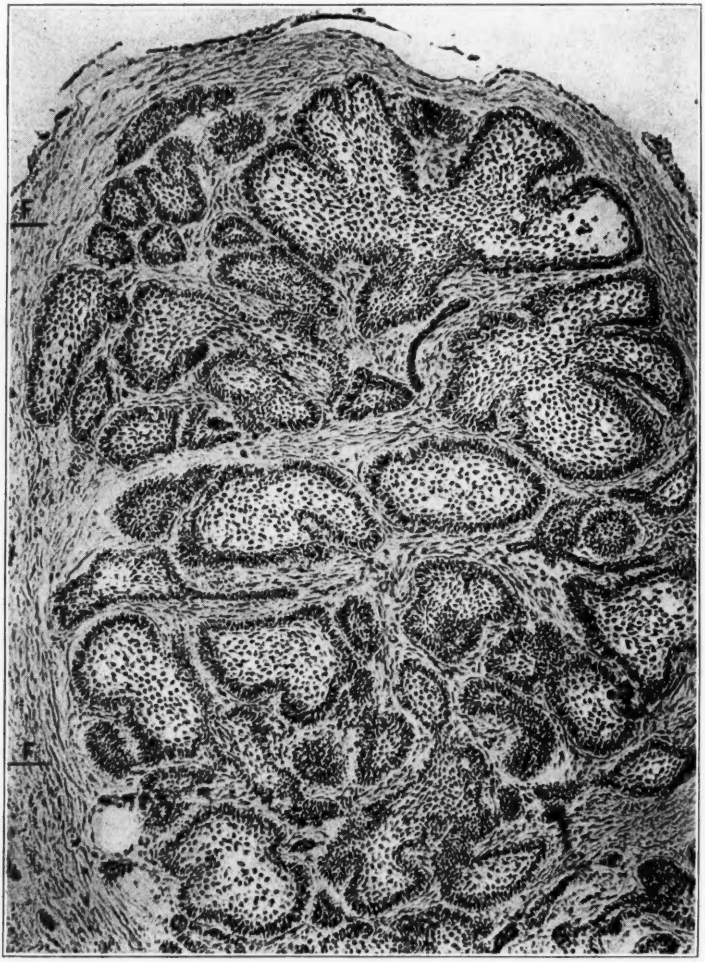

Fig. 9.—Lobe of an adamantinoma consisting of numerous lobules surrounded by a fibrous capsule *F*. (×30.)

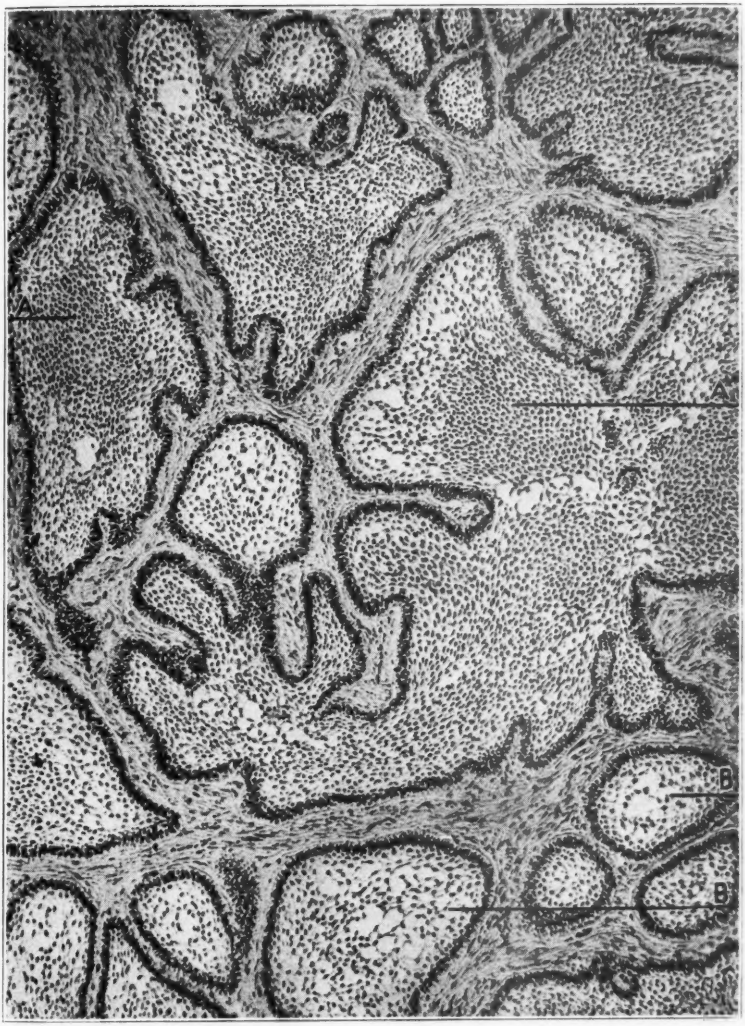

Fig. 10.—Higher magnification of Figure 9. The tumor is built up of lobules which contain stellate reticulum and are lined by cylindrical cells. At *A*, the stellate reticulum is very dense. At *B*, a looser arrangement is shown. The lobules are surrounded by fibrous connective tissue. (×80.)

Figure 1 shows the germ of an upper first deciduous molar of a human embryo, 105 mm. in length. In this section, both the deciduous and the permanent tooth germs are to be seen, joined together and connected with the epithelium of the

mouth by a continuous dental lamina (*DL*). The germ of the permanent bicuspid (*P*) consists of a small solid bud of epithelial cells. Its structure resembles the dental lamina. In the adjacent deciduous molar, the epithelium is already differentiated in an inner layer and an outer layer, and between these two layers is found the stellate reticulum (*SR*). The formation of hard substance has not yet begun. The tooth germ, at this stage of development, consists only of soft epithelial structures.

I have called attention to this photomicrograph because it shows two germs, a permanent and a deciduous one, in different stages of development. Both these germs are connected with the mouth epithelium by a continuous dental lamina. As I now proceed to the description of the different types of adamantinomas, I shall continue to refer to the conditions just observed in Figure 1.

SOLID ADAMANTINOMAS

Solid Adamantinoma Corresponding to the Earliest Stages of Tooth Development.—This type of adamantinoma is clinically a slow growing soft, solid tumor of varying size. Histologically, it consists of a mass of stroma in which very numerous solid cords and strands of epithelium are imbedded, as illustrated in Figure 2 at *A*. In a few places, the beginning formation of stellate reticulum can be observed (Fig. 2, *B*), but otherwise the epithelium is homogeneous and solid. This type of tumor corresponds to a stage of tooth development found in the permanent germ (Fig. 1, *P*), and in the dental lamina at *DL* in Figure 1. This similarity becomes more evident if we observe Figure 3, which shows the mouth epithelium and the superficial part of the tumor. The covering squamous epithelium forms funnel-like depressions (Fig. 3, *A, B*) from the bottom of which the epithelial strands of the tumor can be followed into the stroma.

This relation of the adamantinoma to the mouth epithelium corresponds to the conditions shown in Figure 1, in which the dental lamina connects the tooth germ with the mouth epithelium. The tumor itself can be considered an irregular network of many dental laminae, all connected with each other and with the epithelium of the mouth. On the sides of each dental lamina, there are many small epithelial buds and proliferations (Fig. 2, *B* and Fig. 3, *C*), some of them corresponding to the little irregularities normally found on the dental lamina, and some of them to primitive tooth germs similar to *P* in Figure 1.

The close relationship of this type of adamantinoma to tooth formation can be seen in Figures 5 and 6. Before discussing these figures, I wish to show a buccolingual section through the mesial cusps of an upper first permanent molar of a child, aged 6 months (Fig. 4). Underneath the cusps of this tooth, the dental lamina (*DL*) extends from the outer enamel epithelium of the molar to the mouth epithelium (*ME*). In this section, the uninterrupted connection of the dental lamina with the structures mentioned above cannot be seen because of its curved course; but this connection becomes very evident in following the other sections of this series. The germ of the permanent second molar branches off from the lingual side of the dental lamina.

Figure 5 shows it in higher magnification. At *DL'*, the dental lamina continues to the first molar and at *DL"*, it runs toward the epithelium of the mouth. Some epithelial shoots and buds (*ES*) adhere to the lamina; others (*ES'*) appear to be isolated from the lamina. On the lingual (left) side, a little strand

Fig. 11.—Higher magnification of portion of Figure 10; edges of four lobules. Between the lobules is connective tissue (*CT*) of much more mature type than that shown in Figure 8 at *S*. *SR*, stellate reticulum. *CY*, small cysts forming in the stellate reticulum. *BM*, basal membrane. (×600.)

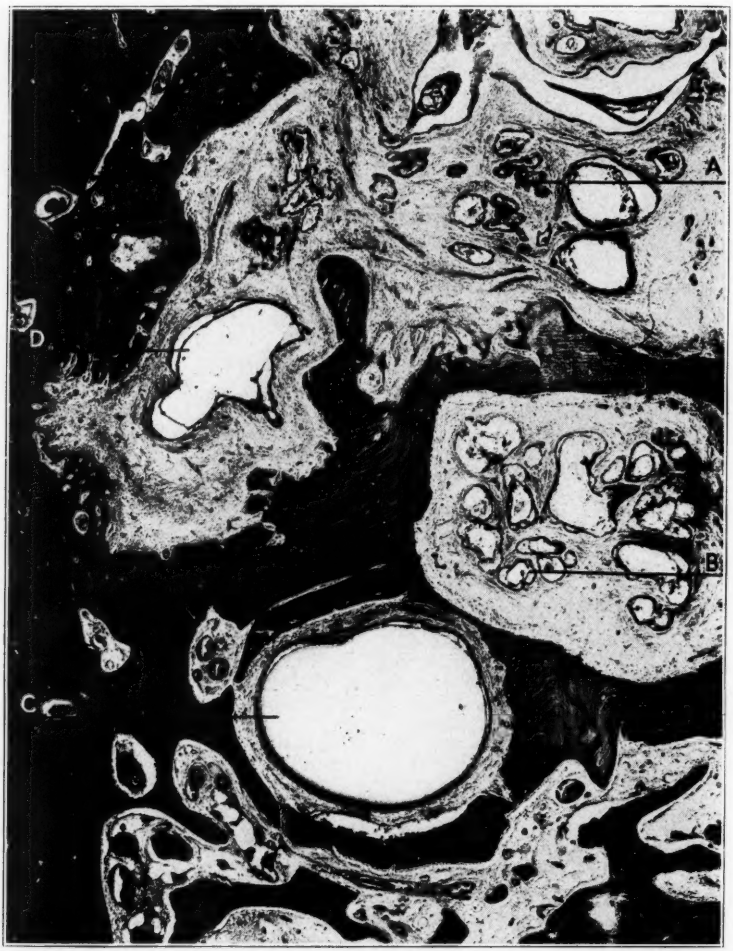

Fig. 12.—Cystic adamantinoma in the alveolar bone. *A, B,* lobules of adamantinoma in different stages of cystic degeneration. *C, D,* individual large cysts surrounded by bone. (×18.)

branches off, connecting the germ of the second molar (*G*) with the dental lamina. The tooth germ, still in a very early stage of development, consists merely of a double row of epithelial cells without further differentiation.

Figure 6 is a photomicrograph taken with the same magnification from the adamantioma seen in Figure 2. An epithelial strand with many little branches and buds closely resembles the dental lamina. On the left side, there is a longer branch, which forms the connection with a terminal epithelial swelling,

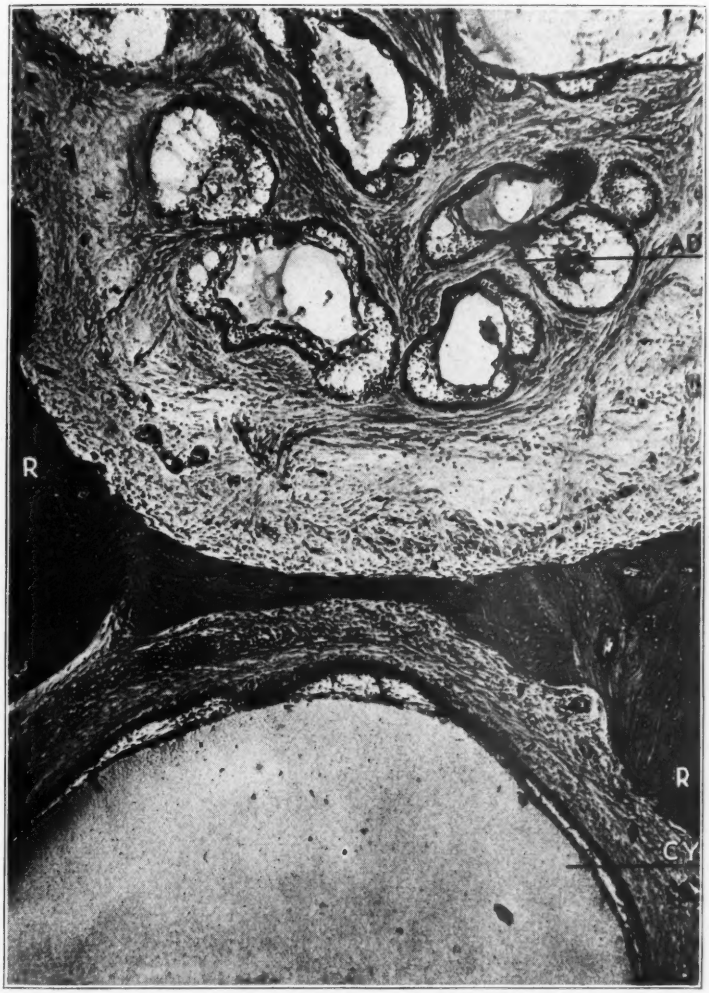

Fig. 13.—Higher magnification corresponding to area *B* in Figure 12. *AD*, lobules of adamantinoma with central cysts in the stellate reticulum. *CY*, single large cyst lined by the remains of the stellate reticulum. *R*, bone resorption due to the pressure of the growing tumor. (×75.)

giving the appearance of a tooth germ. The histologic structure of the epithelial cells in Figures 5 and 6 is similar; whereas, the surrounding connective tissue shows a very marked difference. The dental lamina of the child of 6 months (Fig. 5.) is imbedded in connective tissue of fibrous structure; the stroma of

Fig. 14.—Higher magnification of the border between the lobules at *AD* in Figure 13. *SR*, rarefied and atrophic stellate reticulum. *CY*, cysts forming in the stellate reticulum. *BM*, cylindrical cells and basal membrane. *CT*, connective tissue. (×600.)

the adamantinoma, on the other hand, shows starlike connective tissue cells of embryonic character, corresponding to the early stage of development of the whole tumor (Fig. 6, *S*).

In some places, the epithelial strands of the adamantinoma show a very regular structure similar to that of a gland, as illustrated in Figure 7. Strands consisting of epithelial cells of undifferentiated character form a kind of network. Here and there, epithelial buds branch off from the strands. All the epithelial structures are separated from the surrounding connective tissue by a basal membrane *(BM)*.

In other areas of the same tumor, the cells begin to differentiate at the end of the epithelial shoots. These formations are seen in Figures 2 and 3 as little terminal swellings on the end of the long epithelial strands. A high magnification (Fig. 8) shows that a differentiation of the former homogeneous epithelial strands has taken place. They now form a loose central network of cells, the stellate reticulum, and cylindrical cells on the outside similar to ganoblasts. The entire structure is surrounded by a basal membrane *(BM)*. The surrounding connective tissue (stroma) consists of starlike cells that are without distinct differentiation or arrangement. This formation of a stellate reticulum is the first transitional stage toward the next type of solid adamantinoma.

Solid Adamantinoma Corresponding to a Later Stage of Tooth Development.—This form of adamantinoma is clinically not very different from the one described above. Histologically, it shows a very characteristic structure and is the type of adamantinoma most commonly described in textbooks on pathology. This type of adamantinoma is differentiated from the one formerly described by the large amount of stellate reticulum. The main part of the tumor consists of lobes of stellate reticulum surrounded by cylindrical epithelial cells. Connective tissue forms a fibrous capsule around the adamantinoma and the septums between the epithelial parts. This arrangement, namely, the presence of stellate reticulum and the lining of cylindrical cells, is characteristic of the tooth germ in a later stage of development (Fig. 1, germ of the deciduous molar). Thus, this type of adamantinoma can be considered as a tumor comparable to that stage of tooth development in which the germ consists mostly of stellate reticulum.

Figure 9 shows a part of an adamantinoma of this type. The tumor consists of many lobules of varying sizes and shapes. By means of serial sections, it has been found that these single lobules are only apparently separated and that all the parts are connected (Siegmund).[3] The connective tissue *(F)*, of much riper character than the one found in the former case (Figs. 3 and 6), surrounds the tumor in the form of a capsule. From this capsule, fibrous septums branch off and separate the epithelial lobes. A higher magnification (Fig. 10) shows the stellate reticulum to be regular and dense in some places (for instance, at *A*). In other lobules or areas, the stellate reticulum is much thinner (at *B*) and empty spaces which are small cysts can be seen.

This is more evident in Figure 11. This area is the border of four lobules and illustrates the relation of the epithelial part of the tumor to the stroma. The latter consists of ripe connective tissue, showing nuclei of fibroblasts and a few wandering cells. Occasionally, there are small blood vessels found in the connective tissue between the lobules. The

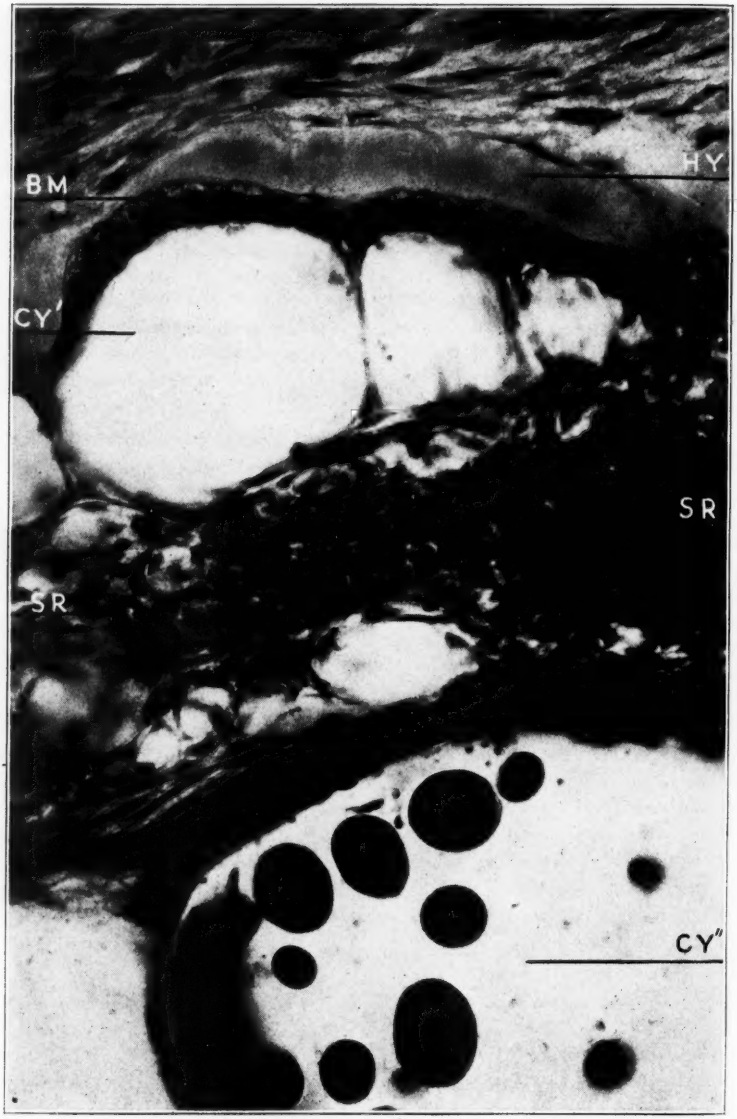

Fig. 15.—Another area from the tumor shown in Figures 12-14. *SR*, solid stellate reticulum. *CY'*, cyst formation between stellate reticulum and outer cylindrical cells. *CY"*, cyst containing drops of colloid. *HY*, hyaline degeneration of the connective tissue adjacent to the basal membrane (*BM*). (×600.)

epithelial part of the tumor is free from blood vessels. The lobules are lined with cylindrical cells having the appearance of ganoblasts, and by a basal membrane, *BM (membrana limitans)*.

The stellate reticulum behind this ganoblastic layer varies in different areas. At *SR*, the cells show a typical regular arrangement, and the intercellular protoplasmic bridges are of uniform length. At *CY*, we see little cysts forming in the stellate reticulum. It seems that, by the accumulation of fluid between them, the cells become separated. Gradually, the small stellate reticulum cysts may join and form larger ones. Thus, these cystic formations must be considered as a transitional stage of the second main type of adamantinoma, namely, the cystic type.

CYSTIC ADAMANTINOMA (MULTILOCULAR CYSTS, MULTILOCULAR CYSTOMA)

The cystic type of adamantinoma can be considered the result of progressive cyst formation in the solid adamantinoma. Although cysts have been found in the connective tissue (stroma cysts, Siegmund), the primary factor in the formation of the cystic adamantinoma is the cystic degeneration of the epithelial part of the tumor (stellate reticulum cysts). Clinically, the diagnosis of cystic adamantinoma or multilocular cystoma is given because of the presence of many cysts in the jaw, from the size of a bean to that of a small egg. In the roentgenogram, the bone seems extensively rarefied, sometimes almost completely gone.

In operations, cysts are found lined by a smooth epithelial wall, communicating with each other and filled with a clear mucous liquid. I recall a case in which cysts of the size of a cherry could be found extending high up into the ascending ramus of the mandible. In another case, one side of the mandible from the angulus to the median line was so thinned by cysts that it was necessary to resect one-half of the mandible, as a spontaneous fracture seemed inevitable.

Histologically, the first evidence of cyst formation has been shown in the stellate reticulum of a solid adamantinoma (Figs. 10 and 11).

I wish now to describe a case in which a piece of the jaw, together with a cystic adamantinoma was taken out and in which the relationship between the tumor and bone can be studied. Figure 12 is a low power photomicrograph of a section through the bone. The tumor in its different stages of development is lying in resorbed areas of bone. Resorption evidently resulted from the pressure of the growing tissues. At *A* and *B*, we find numerous lobules of adamantinoma, showing the typical arrangement seen in Figures 9 and 10. Cystic degeneration varying in extension appears in all these areas of the tumor. At *C* and *D*, there are larger isolated cysts lying in the bone. The cyst *C* is of very regular shape and has exactly the same contour as the surrounding bone from which it is separated by a layer of connective tissue.

A higher magnification of the area *B* shows a part of the cyst *(CY)*, and a part of the more solid adamantinoma *(AD)*. Each lobule of the tumor has a cyst in its center, which, by its growth, presses the remaining stellate reticulum toward the periphery. The large cyst *(CY)* has evidently been formed in this way. In a few places along its surface, the rests of the stellate reticulum can still be seen.

The bone surrounding the cyst and the adamantinoma is entirely lined by osteoclasts. This is an evidence that the cysts are still growing and the pressure of the expansion stimulates the surrounding

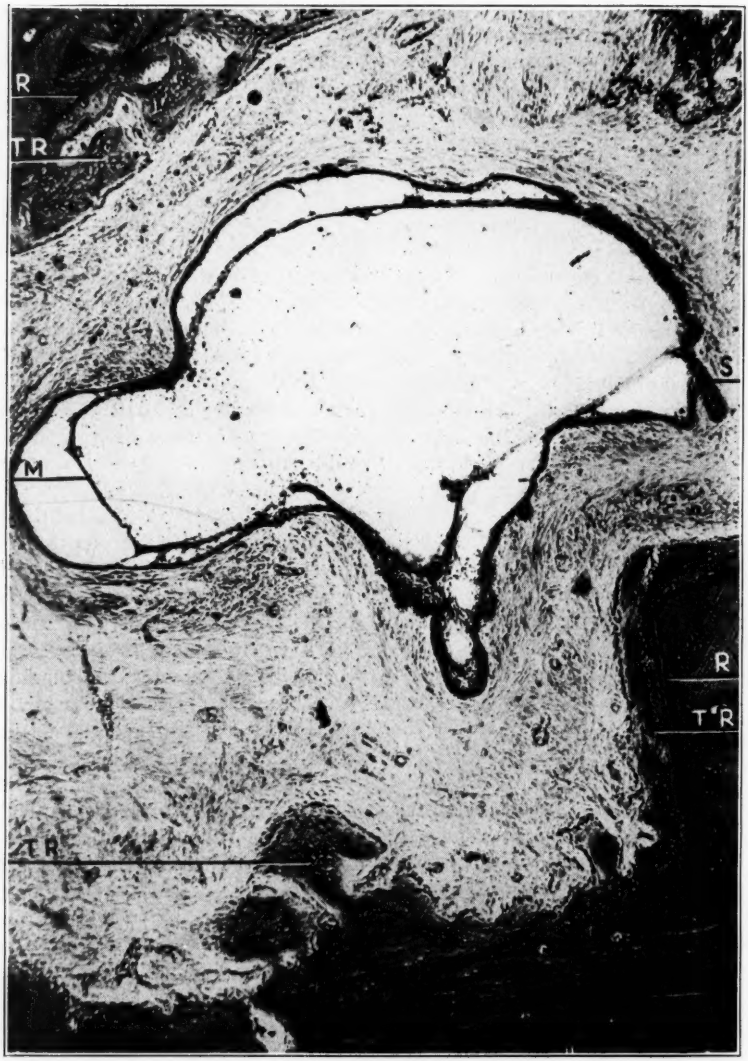

Fig. 16.—Cyst *D* from Figure 12. *M*, membrane in the cyst representing the remains of the former septums of numerous individual cysts. *S*, epithelial shoots on the outside of the cyst wall. *R*, line in the bone up to which resorption originally took place. *TR*, trabeculae of newly built bone. (×75.)

connective tissue to formation of osteoclasts and to resorption of the bone.

A higher magnification of an area of the adamantinoma corresponding to area *AD* in Figure 13 is seen in Figure 14. In comparing Figure 14 with Figure 11, which was taken from a solid adamantinoma, we can easily see the way in which the degenerative changes occur and how the formerly solid adamantinoma becomes cystic.

In Figure 14, the edges of three lobules of the cystic adamantinoma can be seen. Each lobule is surrounded by cylindrical cells which are shorter than the outer cylindrical cells (ganoblasts) in Figure 11. The stellate reticulum *(SR)* inside the lobules is already partly destroyed. Only a few strands of cells are to be seen, and cysts are forming between them. In the center of each lobule, there is a rather large cyst, the content

Fig. 17.—Higher magnification of *S* in Figure 16. *B*, epithelial buds on the outside of the cyst wall. *BM*, basal membrane. (×600.)

of which is either a mucous liquid or acolloid.

The connective tissue between the lobules of this adamantinoma shows only very few nuclei. It is probable that the pressure of the growing cysts has changed the character of the connective tissue. In time, this connective tissue will completely disappear, and then the individual cysts will become joined.

Figure 15 is taken from a part of this adamantinoma which shows all kinds of degenerative changes. At *SR,* there is still solid dense stellate reticulum present. On the outside, cyst formation is everywhere apparent. At *CY'*, there are a few larger cysts with a clear content. They are separated by delicate septums of tissue which are evidently thinned by the pressure and probably will break down. At *CY"*, there is a large cyst containing drops of colloid which appear a bright pink under the microscope. The outer border of the tumor is formed by a single layer of flattened cells. The adjacent connective tissue is changed into a homogeneous pink mass, evidently hyalin *(HY)*.

Another cyst, marked *D* in Figure 12, is shown in Figure 16 under higher magnification. The contour of this cyst is irregular, and it is apparent that it was formed by the confluence of a few smaller cysts. On the inside, there is a membrane, *(M)* evidently the remains of the septums which formerly divided the individual cysts. The surrounding alveolar bone shows evidence of new apposition; namely, newly built bone trabeculae *(TR)* lined with an osteoid border and covered with osteoblasts. The dark line *(R)* up to which the original resorption occurred can still be seen. All the bone inside of this line is newly built.

The explanation of this condition, namely, the fact of a new growth of bone toward the cyst, has been given by former observations of teeth and bone in the neighborhood of growing tumors. It has been shown that the tumor does not grow and extend continuously and regularly, but that its growth is interrupted at intervals, during which new bone and cementum are deposited in the resorbed areas.

In this case, we might assume that, by the confluence of a few small cysts into a large one, a temporary relief from the pressure occurred, and, during this time of relief, new bone was deposited on the old resorbed surface *R*. In a few places, the growth of the tumor is continued on the periphery of the cysts. At *S,* there are shoots of epithelium extending from the outside of the cyst wall. Figure 17 shows this area under high magnification. At *B,* the epithelium proliferates from the cyst wall. These branches are solid and look very similar to the structures seen in Figures 2, 3 and 7. On the outside, a distinct basal membrane *(BM)* is seen, forming the border between the epithelium and the connective tissue. In this way, namely, formation of new epithelial shoots, cystic degeneration, and growth and union of these cysts, the cystic adamantinoma grows, and, unless interrupted by operation, it is likely to destroy large parts of the jaw bone by the pressure resulting from its growth.

SUMMARY

1. An adamantinoma is a soft benign epithelial tumor of the jaws. It is generally rare and is found more often in the mandible than in the maxilla.

2. Clinically, two types of adamantinoma can be distinguished: solid and cystic. The latter is characterized by the presence of numerous cysts of varying size and shape, and therefore is also called multilocular cyst or multilocular cystoma.

3. Histologically, the solid adamantinoma must be considered as a pathologic overgrowth of tooth germ and dental lamina in an early stage of development. If it corresponds to a very early stage of tooth development, it consists merely of numerous solid epithelial strands imbedded in connective tissue, and of stroma.

4. If the adamantinoma corresponds to a later stage of tooth development, it is characterized by the presence of stellate reticulum. The outside of the lobules is lined by cylindrical cells resembling ganoblasts.

5. The cystic adamantinoma develops from the solid type by cystic degeneration of the stellate reticulum. As the cysts grow, they may become joined by destruction of their septums. The cysts have an epithelial lining and contain mucous liquid, sometimes colloid, and the remains of the stellate reticulum.

SLIGHTING THE LITTLE THINGS IN DENTURE CONSTRUCTION*

By B. C. McEuen, D.D.S., Madisonville, Ky.

"I WAS wandering through an art museum one day several years ago, when I was joined by a friend whose knowledge of art would qualify him as an expert. An unusually rare collection of the old Dutch masters was on exhibition.

"I knew that those few pictures were immensely valuable. They were all heavily insured. Two or three of them were pointed out to me as having cost their present owners more than $250,000 each.

"I confess that, in my ignorance of art, I was puzzled. Some of those pictures did not interest me at all. Elsewhere in the museum hung any number of canvases that appealed to me more. Yet these few old masters were being exhibited and studied and praised and admired by people who supposedly knew what it was all about.

"I had sense enough to know that it takes more than age to make a masterpiece. So, standing before what to me was the least impressive of those rare pictures, I said to my art-loving friend:

" 'Why is that particular canvas so valuable? What makes it a masterpiece?'

"He looked at me rather sorrowfully. Finally, he said: 'Well, for one thing, it is a great work of art. Look at the marvelous coloring, which many years have not dimmed. Notice how beautifully the picture is composed so that this part balances that. But over and beyond all these things, the artist who painted it proved his right to mastership by an exquisite handling of the minutest details.'

"Then he began to point out to me, one by one, little things which my untrained eye had entirely missed. Now I saw that the veins in the old man's hands looked as though the blood were still pulsing

*Read before the Section on Full Denture Prosthesis at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 8, 1929.

through them; that the sunbeam coming through the window fell on a mug upon the table in such a way as perfectly to illumine the design on the old drinking piece; that the old man's hat was beautifully done. Why, a singing bird in a cage was a picture in itself!

"Said my friend: 'Only a fine artist does the little things with such fidelity."

"I thought then, and I think now, that pictures and folks grow to greatness in much the same way. It is largely the little things that make a masterpiece of art; it is the little things that make men and women truly fine.

"Human masterpieces are built by patience and thoughtfulness and unselfishness; by courtesy, good manners, kindliness and understanding. The lives of the great characters that we all know and love are filled with tiny details exquisitely done.

"The importance of little things is vividly emphasized in something that a woman said to me the other day. 'My husband would die for me,' she told me with a little grimace, 'but he always forgets to pass me the salt at the table. Probably, he'll never have the chance to die for me, but I need the salt three times a day!'

"And there you are! We all need the salt of human thoughtfulness and kindness many times every day.

"After all, it is our attitude toward life that counts. We shape in the main our own characteristics. We advertise ourselves daily by our conduct in small affairs.

"Lincoln was a human masterpiece, and I think that was because of his attitude toward his fellow men. He recognized the varying degrees of genius and ability; the shades of honor and conduct, and strength and weakness. But he saw also that the crying need of all men is for kindness and sympathy and understanding and friendship. I think he poured as much of his heart and his love and his thought into the letter which he penned to the widowed mother who had given five sons to die on the field of battle as he did in penning the speech at Gettysburg. His life was filled with exquisite details."

Most people feel that when they lose their teeth, they are doomed to facial changes almost beyond recognition, and most people are, to their own humiliation and to the discredit of the dental profession. The laity, we must remember, are at our mercy, and not they but we are responsible for the dot in the world background they present, whether it be a constructive or destructive factor in the great panorama.

In all probability, Nature never intended that we should wear dentures. It is possible that our so-called civilization has done much toward developing a science known as denture construction. And Nature was kind enough to allow a sufficient foundation for the building of a mechanical mouth, if we are kind enough to regard her physical laws, of which we will mention first, the law of self-preservation, or, in dental terminology, we might say the physical law of effect of trauma on human tissue. The old law, that there is an equal reaction for every action, might truly be used in this description, inasmuch as the bone contains two active cells. These cells were evidently placed in the makeup of bone for a very definite purpose, and are regarded by the orthodontist as the fundamental controlling factor in the regulation of teeth. They are just as much a fundamental consideration in the construction of dentures as they were during any time when the patient enjoyed a full complement of teeth. When

we acquire an excess of hypertrophied tissue under an unbalanced denture, it is certainly no mystery—only Nature's effort to relieve a disturbance in circulation due to excessive localized trauma. It is understood that I am not attempting to give or go into any technic for the balancing of occlusion. I believe everyone realizes that necessity, but we are too often negligent in its application.

THE VALUE OF THE ROENTGEN RAY IN DIAGNOSIS

The value of the roentgen ray in diagnosis cannot be too greatly emphasized. Aside from giving us an accurate checkup on roots, cysts, spicules, etc., it furnishes the only possible means of determining the character of the osseous foundation upon which we are to build. It furnishes the only means of our knowing whether we are maintaining a normal osseous structure before trauma through occlusion has wrought destruction. A smooth healthy scar in soft tissue indicates a satisfactory healing. A smooth well-formed cortical layer in bone indicates a satisfactory healing of hard tissue.

EXPECTATION OF PERFECTION IN DENTURE-WEARING PATIENTS

An automobile salesman insisted that I needed a much better car than the one I was driving. When I told him that the one I was driving was very satisfactory and did all that I required, and I asked him why I should want a better one, his answer was, "A boy who has slept on the floor all his life may ask for nothing better, but if you put him on a feather bed for a while, it is hard to get him to return to the floor for his sleeping quarters."

Applying this to dentures seems to answer many questions. The patients who have enjoyed an efficient masticating service, but for some reason have to lose the teeth recall the pleasure afforded by a perfect masticating machine and cannot forget it. It is hard for them to acquire perfection with bases rather than fixed teeth. There can be no standardization of instruction that will apply to each individual either through print or verbally. The situation sometimes becomes monotonous to us, and it is easy to overlook the many bits of education that mean so little to us but are paramount in the patient's mind, being necessary to his success in his new venture.

ESTHETICS

If we assume that Nature intended that our teeth should last and function a lifetime, it necessarily follows that she made no provision for taking care of the facial contour until the ridges were prepared for their reception. We find the reverse to be true when the teeth are lost. Nature cares nothing more for facial appearance but immediately begins to readjust the facial muscles to a newly acquired position in order to bring the ridges together so that some form of mastication can be reestablished. Therefore, we have a completely changed expression, never to be completely regained if we permit it to be lost.

CHANGE IN TASTE OF FOOD

Many patients complain of an entirely changed taste in their foods, and this no doubt is actually true in all cases. I have no criticism for the theory that all taste bulbs are contained within the tongue, yet it is not to be expected that patients can enjoy the same flavors with so much artificial material replacing the natural. If they happen to be of a temperament to accept easily the new and forget the old, they will acquire a taste equally enjoyable and real. This is not usually an annoying complaint of long standing because they acquire a new taste with a

newly necessitated condition. It is not my intention to offer anything technical, but I cannot refrain from mentioning what I believe to be a factor aside from the importance of balancing occlusion. There are certain fundamental factors involved in the making of an impression that must be mentioned before many ideals can be realized. One is distribution of pressure incorporated in the impression harmonious with the density and character of the soft tissue over the foundation upon which we are attempting to build. The term "dental prosthesis" embraces the application of art and mechanics, a systematic and orderly arrangement of knowledge of forms, causes and laws, facts and truths. A recognition of the call of need, as Charles Hall saw it when he made aluminum practical; the call of vision, as Alexander Bell saw it; the call of opportunity, as Rockefeller sees it while he keeps the wheels of his institute in motion in the interest of humanity.

DENTAL DIETETICS

By ARTHUR L. FORSTER, M.D., Chicago, Ill.

A SURVEY of medical literature of the past five years shows that as much space has been devoted to the teeth as to any other structure of the body. Their normal condition is now recognized by clinicians as tantamount to the wellbeing of the entire organism, which explains why dentistry has become one of the most notable and highly specialized arts in the world. The public today demands of a dentist a degree of knowledge of correlated subjects that would make his colleague of the last generation gasp.

Since diet exerts a profound influence on the structure and stability of the teeth, the modern dentist is rightly expected to be conversant with dietetics, at least as far as it relates to his specialty. As an etiologic factor in disease, the part played by the teeth is tremendous, making their conservation a matter of far-reaching consequence. Whatever will contribute to the formation and preservation of sound teeth, therefore, becomes a public health measure of no mean dimensions.

There is no question that, as Dublin and Hyatt say, "the most important single factor determining the structure of the teeth and their susceptibility to disease is the influence of the diet." Ninety per cent of school children have carious teeth. It would seem, then, that the attention paid the diet of infants and children by pediatricians may well be complemented by the dentist.

There can be no more important single phase of preventive medicine than preventive dentistry.

There are two periods in which diet exerts an influence on the formation of the teeth. The mother's diet during the period of gestation determines the structure of the teeth of the child, and, secondly, the diet of the infant during the first two years of life contributes a great deal to their quality.

DENTAL DIETETICS IN THE PRENATAL PERIOD

With reference to the expectant mother's diet, it may be said that the conditions which cause her own teeth to become carious likewise affect the structure of the offspring's teeth. While heredity has some influence on the teeth of the child, it is not unlikely that its importance has been considerably overrated. Good teeth in all members of a family are probably due to the same healthy environment, correct diet and the proper care in which all members of the household share. Moreover, a study of the metabolic alterations incident to pregnancy indicates that they are a far more significant factor than heredity in the quality of the teeth of the offspring.

It follows that one phase of dental dietetics which should be emphasized is that which concerns the prospective mother. While many physicians advise such patients regarding their diet, this subject is frequently overlooked. Hence, the dentist should inquire into the patient's dietary habits and make whatever adjustment is necessary.

A woman should receive an abundance of milk, fruit and vegetables during pregnancy to insure healthy teeth in the child. As is well known, these articles are especially rich in vitamin D (antirachitic), lack of which is probably the most important factor in producing teeth of poor quality.

DENTAL DIETETICS IN INFANCY

In an exhaustive and detailed study made by Louise O. Kappes of the Mayo Foundation, for the purpose of evaluating the possible etiologic factors in dental caries, it was found that breast feeding seemed to be an unimportant factor. Analysis of the two groups of school children studied also seemed to contradict the popular belief that an infant who cuts the teeth late has better teeth than one who cuts them early.

There is no question that use of a diet which is deficient in vitamin D results in defective teeth almost without exception. The development of the teeth is analogous to that of the bony skeleton. If the diet makes for proper calcification of the general bony structure, the teeth will develop normally. If rachitic phenomena exist, the development of the teeth is proportionately retarded and their quality impaired.

It is generally conceded that interference with calcification is less likely to occur before birth than afterward. It is during the early months of life, when the teeth are developing in the jaws, that the influence of diet is most profound. Before birth, even if the prospective mother is on a deficient diet, the fetus will usually be adequately provided with vitamins and minerals by drawing on the maternal stores.

As the infant is restricted to a milk diet during the first months, it is important that the pabulum be of a type that is readily digestible and assimilable. A food may be rich in vitamin D, but it becomes valueless if it is not made available. This, no doubt, is why so many pediatricians today advocate the use of evaporated milk as the basis of infant feeding formulas.

The question is raised as to the vitamin D potency of a milk which is subjected to a degree of heat treatment capable of bringing about the abstraction of 60 per cent of its water and the destruction of all bacterial life. Experiments made in this connection show that the juice of canned tomatoes is as rich in vitamin D as that of fresh tomatoes. The reason for this is that the heat treatment of all canned foods takes place in a vacuum, under which conditions a lower tempera-

ture is required to produce effects not possible in an open vessel. Thus, the evaporation of milk is accomplished at a temperature of 130 degrees in the vacuum pans used for that process, while for the same effect 212 degrees would be required for a longer period of time, if the process were attempted with open cooking.

People are given to thinking of foods bought in their native states as more fresh and wholesome than the same foods marketed in sealed containers. Such a distinction is frequently misplaced. It is now possible to obtain canned soup specially prepared for infants, as well as canned strained vegetables—spinach, peas, carrots, etc.—which are actually fresher and more nutritious than the wilted, lifeless products sold in vegetable stores. Vegetables that are to be prepared for canning are selected with the greatest care and are in sealed containers a few hours after they are taken from the garden. Moreover, they are allowed to ripen naturally in the sun, which adds materially to their nutritive value. Fruits and vegetables that are to be marketed in their raw state are gathered while still "green" to prevent spoilage during the time elapsing between their harvesting and delivery to the ultimate consumer. Such products are immature and lack many of the elements which are acquired only in the process of natural and complete maturation.

Dentists will find themselves relied on more and more for correct information on the subject of dietetics, especially with reference to the rapidly enlarging use of concentrated foods. It may appear a little like paraphrasing Don Quixote to say that some day the world's food will come in capsules and that man of a future epoch will no longer possess anything but an anomalous digestive system. That is doubtless somewhat far-fetched. But if the present trend is any augury of the future, a progressively greater use of concentrated and preserved foods can be anticipated. The transportation and storage costs, together with the loss from spoilage of food products, constitute an economic problem that is becoming more and more insistent.

So with milk. There is a distance beyond which it is neither safe nor economical to ship a product consisting of 7 parts water and 1 part food; which explains in part at least the present insufficient use of milk per capita.

DENTAL DIETETICS AFTER THE FIRST YEAR

There are two ways in which the teeth are affected by conditions connected with the diet: 1. Food lodged in the interstices of the teeth undergoes changes which lead to alterations in the enamel. 2. The diet may modify the secretions of the mouth so that at least indirectly the teeth are acted on adversely by it.

There is no question that diet is responsible for dental caries to a greater extent than the combined influence of a bad heredity, infectious diseases and lack of care. A more detailed consideration of the *modus operandi* of the two dietetic influences enumerated above amply substantiates this contention.

The accumulation of food remnants between the teeth is a prolific cause of dental caries. This is particularly true of carbohydrate foods. And albeit this class of foods must always preponderate in man's diet, their use when they are in their proper form can have no adverse effect on the teeth. The so-called refinements of our diet may have produced food products of better appearance, but they have been devitaminized in the process. The life has been taken out of

them. They may be the "kernel of the nut," but in this instance the shell is of more value than the kernel. Illustrative of this is white flour and its many derivatives. The absurdity of modern dietetic practices is nowhere better exemplified than in the custom of eating products made with white flour, and ingesting a quantity of bran in the morning and a dash of lubricating oil in the evening.

When people learn to eat foods in the natural state, dental caries and its unwelcome sequelae will become comparatively rare. Horses seldom brush their teeth, and yet they suffer little from caries. Brushing the teeth is necessary in human beings only because of their dietary errors. The beautiful white loaf of bread so proudly displayed by the housewife is but the wraith of what the "staff of life" should be. Whiteness is as much a sign of death in a loaf of bread as in anything else.

The second way in which diet induces dental deterioration, through modification of the saliva, is equally important in its bearing on dental dietetics. Certain classes of food produce an acidotic state of the entire body, including the saliva, which should have an alkaline reaction.

To overcome this tendency, many persons eat acid-forming foods, and drink a quantity of alkaline salts to neutralize the acid. Theoretically, this would seem to be a correct procedure, but clinically it is erroneous. The production of the acidotic state does not consist in an accumulation of acid in the system. It is caused by a deficiency of the alkaline bases, so that the relative amount of acid is increased. The only method by which the acid-base equilibrium of the body can be maintained at a proper level, dental caries and its evil congeners being thereby prevented, consists in eating a proper amount of fruits and vegetables. These have a mechanical as well as a physiologic action. The mastication required removes adherent particles of other foods from the crevices in the teeth and strengthens them through usage. The enamel of the tooth may be the densest structure in the body, but this is no guarantee against its speedy disintegration under adverse conditions.

During the past summer, the health commissioners of Chicago and St. Louis (there may have been others) were compelled to prohibit the use of cream fillings by bakers because of the large number of cases of poisoning resulting from the use of infected milk. During the same season, a number of outbreaks of communicable diseases of various types developed in different parts of the country, which means that the use of milk for general culinary purposes is not an unmixed blessing. Despite the laws governing the pasteurization of milk, much unsafe milk finds its way into the home. This is not surprising when we recall that there are 21,000,000 cows distributed over about 4,000,000 farms in the United States.

SUMMARY

Preventive dentistry is becoming an important division of the healing arts, and since diet exerts a greater influence on the teeth than all other conditions combined, dietetics is the most important subject related to dentistry.

The diet of the expectant mother influences the structure of the teeth of the child far more than does heredity. Hence, it is the duty of dentists to advise mothers regarding diet as a means of conserving their own teeth as well as those of their offspring.

The principal cause of poor teeth is a vitamin D deficiency in the diet of infants. Milk is an important source of vitamin D.

Errors in diet are responsible for caries of the teeth to a greater degree than heredity, infectious diseases and lack of care, combined.

Accumulation of food particles in the teeth, change in the saliva and systemic changes resulting from vitamin D deficiency are the three ways in which diet produces dental caries.

The extended use of milk in a safe form, and a diet rich in fruits and vegetables, are the greatest guarantee of sound teeth.

In view of the important relation of diet to the structure and stability of the teeth, it behooves the dental profession to give this subject closer scrutiny, study and attention.

30 North Michigan Avenue.

MALPOSITION OF A LOWER LEFT MOLAR

By CHARLES L. TOOLE, D.D.S., Cochran, Ga.

A NEGRO boy, aged 17 years, well developed and normal, a month before had presented himself for treatment, the face being lanced in the region of the lower left molars. Some relief was afforded, but there was soon a recurrence of the pain and of the swelling, which was so great that the gum and buccal mucosa was closely adherent. It was impossible to palpate because of the swelling. An incision one and one-half inches long was made at the base of the left mandible, and anterior to the angle. The bone was chiseled away and a molar removed. I have never seen a similar case and to me it was interesting.

Lower left molar in malposition.

REMOVAL OF IMPACTED TEETH UNDER CONDUCTION ANESTHESIA*

By P. G. PUTERBAUGH, M.D., D.D.S., Chicago, Ill.

THE past twenty years has witnessed a great change in sentiment regarding anesthetics. The discovery of procain has made possible to the general practitioner the performance in his office of extensive operations which he would not dare to attempt without it. It has supplanted nitrous oxid entirely in a great many dental practices, and today probably less than 20 per cent of offices are equipped for nitrous oxid administration. On the other hand, since many exodontists do little work under procain anesthesia, in actual practice the personal experience of the operator has much to do with the choice of the anesthetic.

If we could eliminate the use of the hypodermic syringe, the adoption of procain would be universal; because most of the soreness, sloughing of tissue, after-pain, infection, breaking of needles, etc., result directly from the use of the hypodermic syringe.

Bathing tissues in distilled water causes swelling of the cells by disturbing the osmotic balance. All human tissues contain a definite percentage of crystalloid salts; principally the chlorids of sodium, potassium and calcium, to approximately 0.6 per cent. The absence of these salts in anesthetic solutions causes too much water to be imbibed by the tissue cells; which causes swelling and mechanical injury and may even rupture the cell walls.

This disturbance within the tissue cells caused by hypotonic solutions accounts for much of the smarting, pain, swelling and after-soreness following the administration of some of the ready prepared solutions. These symptoms can be avoided by the addition of sufficient salts to make the osmotic balance equal that of the human tissues, and by the employment of freshly prepared solutions.

Solutions should be injected hypodermically with little local irritation save that resulting from the introduction of the needle. If much soreness occurs after the injection of a correctly prepared solution, it is usually traceable to excessive force used in expelling the contents of the syringe.

A 1 per cent solution of procain is satisfactory for infiltration anesthesia in minor surgery, such as simple extraction, and for conductive anesthesia in the upper jaw, where the nerve trunks are of small diameter; but for conduction anesthesia of the heavier mandibular nerve, a 2 per cent solution should be used. The stronger solution is quite necessary here in order that the drug may reach the central fibers of the trunk in sufficient concentration. If a 1 per cent solution be used here, anesthesia of the lip and soft tissues supplied by the outer fibers will ensue, but the central fibers, being unaffected by the weak solution, will retain their function, and incomplete anesthesia will result.

*Read before the Northern Ohio Dental Association, June 3, 1929.

Following the discovery and isolation of the blood-pressure raising principle of the suprarenal gland, it was suggested that the combination of epinephrin with local anesthetic solutions would intensify and prolong the period of anesthesia by preventing rapid dissipation and absorption. Clinical evidence has proved this to be true; while it also, for the same reason, was found to possess the additional advantage of preventing toxic symptoms. Thus, cocain may be employed in 0.5 per cent solution when combined with epinephrin, with results equal to a 2 per cent solution without epinephrin as far as anesthesia is concerned and with less danger of development of toxic symptoms.

Locally, epinephrin constricts the smaller blood vessels by direct stimulation of the circular muscle fibers. On injection hypodermically, this is evidenced by an ischemic area surrounding the site of injection for a distance of from 1 to 2 cm., which lasts from thirty to sixty minutes. After a time, the effect wears away, and a condition of vasodilatation ensues, probably from exhaustion of the muscular coats.

Briefly, the ideal anesthetic solution is composed of freshly distilled water, as a vehicle, 2 per cent procain as the anesthetic agent, sufficient chlorids of sodium, calcium and potassium, as in Ringer's formula, to render the solution isotonic with the body fluids, and epinephrin to localize and retain the anesthetic mixture. The solution thus compounded is sterilized by boiling immediately before its injection.

Deep tissues are just as subject to "catching cold" as respiratory mucosa, and the chilling of the site of injection by carrying a cold solution into tissue unaccustomed to temperature changes is dangerous. Lowering of resistance and retardation of tissue repair can be avoided by injecting warm solutions. If the anesthetic solution is drawn into the hypodermic syringe soon after boiling, and a slow injection made, it will be just about body temperature by the time it reaches its destination.

We must also consider the amount of force needed for injection, remembering that even a small amount of pressure will injure tissue. Areas of necrosis 1 cm. or larger in diameter have occurred because of this. These areas occur most frequently in the upper and lower bicuspid regions and are the result of hydraulic pressure during the act of forcing the anesthetic solution into the tissue. Fixed tissue cells are bathed in lymph, and serious damage is sure to result unless plenty of time is allowed during the injection for the lymph to escape ahead of the anesthetic solution. In order to avoid mechanical injury, only a very slight pressure on the piston is permissible during the injection. At least one minute should be consumed in emptying the syringe into loose tissue, and two or three minutes will be needed for firm tissue.

The site selected for the primary insertion of the needle in the upper jaw should be immediately over the root of the tooth to be operated on, and at the point of reflection of the buccal or labial mucosa. Here, there is a much poorer sensory nerve supply than in the gingivae, and it is possible to make the needle insertion with a minimum of pain. The submucosa there is loosely constructed, with large intercellular spaces, allowing the introduction of anesthetic solutions with little pressure, there being an easy interchange of anesthetic and lymph.

In introducing the needle, we carry it upward and inward, with the beveled side facing the periosteum, until it is felt

to engage in that membrane. Two or three drops of solution, expelled just as soon as the needle enters, will make its final seating entirely painless. One cubic centimeter deposited over the apex is ample.

The mucous membrane in the palate is similarly injected at a distance of one-eighth inch from the gingival margin, seven or eight drops of solution being deposited. Eight minutes is the standard time to allow for the anesthetic to be absorbed, computed from the time of making the buccal injection. One of the most frequent causes of imperfect anesthesia is the fact that the operator, after making a satisfactory injection, begins the operation immediately, not waiting for the anesthetic to act on the nerve fibers. All of the local anesthetics in common use require from five to eight minutes' contact with nerve endings or nerve fibers to produce anesthesia. When we allow for diffusion throughout the injected area and sufficient time for the drug to be absorbed, ten minutes from the time the injection is started is not too long to wait for anesthetization of any of the small nerve fibers, and fifteen minutes is needed for the larger trunks.

For the removal of superficially seated roots that have only a little bony process supporting them, infiltration may be made by injection on the buccal and lingual surfaces. For the lower incisors and the upper teeth, the infiltration of 1 c.c. of solution over the apices of the roots on the labial surfaces, and 0.5 c.c. on the lingual aspects will obtund sensation. For the extraction of lower incisor teeth, infiltration is often preferable to conduction, since the latter affects the entire side of the face, producing paresthesia for an hour or two, and is annoying to some patients.

Almost everyone who has practiced conduction anesthesia has found that, with experience in its use, he employs it more and more. This is accounted for by the simplicity of the injection, the small amount of solution required for blocking large areas, the slight postoperative soreness and the absolute anesthesia obtained. Patients can be placed in the position most convenient for the operator, and there is no swallowing of blood and no vomiting after the operation is over. Anesthesia will usually last until the patient reaches home, which is highly desirable.

The usual conduction technic is recommended for all operations on the mandible posterior to the cuspids. Its use is most gratifying because of the perfect anesthesia and because operative technic in the mouth is much simplified by having the cooperation of the patient.

Local anesthesia has brought the performance of a great many operations in oral surgery within the scope of the general practitioner of dentistry. Removal of submerged and impacted teeth, formerly requiring the services of the oral surgeon or hospitalization of the patient, or both, is brought, by local anesthesia, within the ability and scope of most general practitioners in their offices. Cysts, epulides and other new growths can also be dealt with much more satisfactorily under local than under general anesthesia.

It is undoubtedly true that local anesthetics do disturb the tissues at the site of injection, the degree of disturbance being as variable as the personal equation of the patient. Patients should not be deceived in this matter; but it should be made clear to them at the outset that some after-soreness in the area injected is more desirable than the mortality risk, nausea and discomfort of a prolonged general anesthesia. Speed in surgery is

most desirable within reasonable limits, but, on the other hand, good surgery demands the same attention to minute details as does the construction of fillings or crowns, and it is my firm belief that the practice of rushing headlong through a surgical operation is just as much to be deplored as undue haste in the performance of any other task. Procain permits sufficient time for careful work.

Opinions differ quite widely regarding the indications for extracting unerupted and impacted teeth. I shall briefly outline here a few principles upon which I base my decisions in practice. Many surgeons become so enthusiastic over their calling that they become obsessed with the idea that every vermiform appendix, every tonsil and every unerupted tooth should be removed. There are patients everywhere who have been "operated" into nervous wrecks and who give mute testimony to the harm which can be done by such radicalism. The pendulum in oral surgery has reached its limit in this respect, and I am happy to say is now in the most rational position that it has ever occupied.

New growths arising from tooth follicles usually demand the removal of the teeth involved at the same time the growths are removed.

The mere fact that teeth do not erupt at the expected time is not alone to be regarded as an indication for surgical interference. Good surgery should always result in benefit to the patient; the patient's health and well-being must be improved over what it was prior to the operation. If surgical prophylaxis is practiced, there must be present some condition that predicates imminent danger or discomfort in order to justify the operation. There is not sufficient justification to remove all unerupted teeth simply because a few of such teeth, if allowed to remain, may, in the dim and distant future, cause nervous or other symptoms which will demand their removal.

Recent studies in dental histology have, by improved technic, conclusively demonstrated that there are rarely present any so-called dead spaces about unerupted teeth, but that, on the contrary, there does exist a perfect nutritional attachment of all portions of the teeth, including the outer surfaces of the enamel, with the surrounding tissues. Unerupted teeth, then, from a nutritional standpoint, are not to be looked on as being more susceptible to localized infections than are any other tissues of the body which are submerged beneath skin or mucous membranes. Teeth which are imbedded in normal structures and are not impinging on other teeth should not be regarded as probable sites of infection and should not be removed unless positive nervous or mental symptoms are present.

Embedded teeth whose eruptive forces carry them into impaction with other teeth often should be removed as a preventive measure, to avoid extensive pressure-resorption of the other teeth, or the danger of producing malalinement of teeth already erupted in the arch. Such teeth often cause periodic pressure symptoms as though the molar teeth were being crowded or extruded, or there was wedging in the incisor region.

Teeth embedded in "roentgen-ray normal" structures but which are believed to be accountable for nervous phenomena should be removed. The most frequent symptom associated with teeth of this type is pain in the region of the embedded teeth. Pains are prone to radiate to the posterior auricular or occipital regions, but occasionally are felt in the temporal regions. These symptoms are often periodical, occurring at intervals of three to

four months and lasting from three to six weeks at a time. They should not be confused with the many obscure symptoms of the menopause, differentiation of some of which requires very fine diagnostic skill. Many forms of insanity, especially dementia praecox, demand the removal of all embedded teeth. Anyone who reads Dr. Cotton's monograph will be convinced that this rule should be rigidly adhered to. Patients afflicted with mental diseases should be handled with caution because the operation and aftercare incident to the removal of embedded teeth may prove to be a serious strain on an already overburdened nervous system. Consultation and advice of the attending physician should always precede the decision to remove teeth of this class. We have seen instances in which neurotic patients have been seriously injured by meddlesome and ill-advised operations for the removal of innocently embedded teeth. In this connection, I desire to state that I have never seen a case of tic douloureux that has been permanently improved by the removal of any teeth.

Embedded teeth which have become involved by extension of infective processes affecting adjacent teeth should be removed; for the reason that, when the investing tissues are once injured, there is little likelihood of their ever freeing themselves of infection. Likewise, partially erupted teeth, if so placed that full eruption is impossible, should be removed as a prophylactic measure; for experience has taught us that nearly all such teeth eventually become the seat of purulent infections, which are distressing and often grave in their consequences.

Extraction of teeth whose overlying coronal tissues are the subject of acute infection is distinctly contraindicated. Extraction here should be delayed until after the infection has been brought under control by irrigation and antiseptic treatment and the virulence of the invading organisms has been attenuated. This usually takes from a week to ten days, but serves to avoid the extensive involvement of tissue that is likely to take place if immediate operation is performed in the presence of active infection. Irrigation once daily with 4 per cent boracic acid solution, followed by thorough application of compound solution of iodin (Lugol's) worked within the gingival crevice with fine instruments, is the usual treatment. If localization of pus occurs in the soft tissues, it is drained by incision as soon as diagnosed, but under no circumstance should the tooth be removed until the acute inflammation has subsided.

When it has been decided that impacted teeth be removed, the operation should be carefully planned from a study of the patient, in conjunction with good roentgenograms of the operative field. A technic should be decided on that will permit the removal of the teeth with a minimum of destruction or injury of tissues, within a reasonable working time, because wounds that are kept open for a long time heal poorly.

Asepsis must be studiously observed, and although these wounds are treated by the open method, the introduction of foreign organisms is always fraught with grave danger. All operative instruments can be readily boiled, and this includes handpiece sleeves, syringe wrenches and other articles that must necessarily be handled by the operator or nurse. Warm boracic acid solution should be employed in a sterile syringe for irrigating the wounds at the time of operation, and everything should be in readiness in order to avoid delay after the operation is begun, since each minute's delay means additional lowered healing power of the tissues.

Alveoli left by ordinary extractions are lined with peridental membrane, which protects the bone from exposure to the oral fluids. The blood clots are penetrated by capillary loops from this membrane, the cells forming the clots are kept alive and the socket is filled with fibrous tissue within a week or so without exposure of the alveolar process.

Quite a different condition is established during the removal of embedded and impacted teeth. In the first place, we must remember that it is not only the root portion but the entire crown of the tooth as well that is embedded, a cavity at least twice the size of an ordinary extraction wound resulting. The removal of impacted teeth requires the cutting away of osseous tissue, which leaves exposed bone lining the wound. Bone as a tissue has very poor reparative power. Since it cannot proliferate capillary loops as does the peridental membrane, the primary coagulum which forms in such wounds undergoes liquefaction necrosis, the surface bone undergoes inflammatory reaction and healing gets under way very slowly. Pain incident to the osteitis is a constant symptom, persisting until granulation tissue has covered the exposed bone. When the osseous surfaces of the wound are protected by the eventual proliferation of connective tissue, pain and soreness diminish and the putrefactive odor so characteristic of bone injuries disappears.

Soft tissues should never be sutured tightly over large bone cavities without provision for drainage, since clots will invariably break down and putrefy, leaving a suppurating area that is very undesirable. It is better surgery to treat all impaction wounds by the open method from the outset, providing drainage for stagnant fluids and preventing extensive osteitis by daily irrigation and antiseptic dressing of the wounds.

The first dressing is of plain or 3 per cent iodoform gauze lightly tucked in place. This will control hemorrhage and protect the wound from oral fluids. After forty-eight hours, this dressing is removed, and the wound is irrigated with warm 4 per cent boracic acid solution, dried and dressed with 15 per cent procain paste in an anhydrous wool fat (lanolin) base containing benzoin and thymol iodid. This will control pain and obviate infection. The latter dressing is repeated at twenty-four hour intervals until the exposed bony surfaces are completely covered by granulation tissue, when it may be discontinued.

Amidopyrin, in 5 grain doses, is administered by mouth every four hours for the first two or three days, and thereafter at bedtime if required to control pain.

Cold, in the form of ice-packs, is applied externally for the first five hours to prevent the occurrence of swelling after the removal of impacted third molars.

CONCLUSION

I would urge everyone to weigh most carefully the evidence of pathologic change in the jaws in conjunction with the general health of the patient before advising surgical treatment. When an operation has been decided on, it should be performed carefully and in the shortest time that is compatible with a careful, well-planned surgical technic.

STUDIES IN RICKETS. IV. RELATION OF DIET DURING PREGNANCY TO THE DECIDUOUS TEETH*

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LAST year at the annual session of the American Dental Association, papers were read by F. L. Schlutz[1] and F. L. Adair[2] that well summarized the studies and theories as to the effect of prenatal diet on the teeth of the offspring. The comment was made that further experimental work in this field was necessary.

During the past five years, we have been studying the effect of diet during pregnancy, and other factors, on the development of rickets. The idea was recently conceived by one of us (J.V.G.) that the material at our disposal might throw some light on the relation between the prenatal diet of the mother and the teeth of the offspring.

TABLE 1.—DIETARY IN ONE CASE STUDIED

	Calories	Calcium Gm.	Phosphorus Gm.	Iron Gm.
Milk, 4½ cups	720	1.174	0.904	0.00247
Egg, 1	84	0.030	0.082	0.00128
Bacon, 2 slices	50	0.001	0.016	0.00022
Oatmeal, 1 cup	100	0.008	0.049	0.00048
Bread, 3 slices	109	0.027	0.039	0.00039
Butter, 1 teaspoonful	33	.....	.....	0.00001
Potatoes, 2	200	0.032	0.138	0.00312
String beans, 2 cups	100	0.088	0.100	0.00212
Tomatoes, 2 slices	8	0.005	0.011	0.00008
Corn, 1 ear	100	0.008	0.136	0.00105
Chicken, 1 piece	100	0.012	0.216	0.00300
Gravy, 1 tablespoonful	66	0.002	0.008	0.00007
Candy, 2 pieces	100	.....	.....	.....
	1,770	1.387	1.699	0.00929

In our original study,[3] the diets of twenty-five prospective mothers were actively regulated during the last half of pregnancy, the foods being sent into the homes and prepared under the direction of dietitians from the department of nu-

*From the B. K. Rachford Department of Pediatrics, University of Cincinnati, and the Babies Milk Fund Association of Cincinnati.

*Read before the Section on Orthodontia at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 9, 1929.

1. Schlutz, F. W.: Preventive Dentistry from the Point of View of the Pediatrician, J.A.D.A., 15:2311 (Dec.) 1928.

2. Adair, F. L.: Prenatal Care and Diet, J.A.D.A., 15:2319 (Dec.) 1928.

3. Greenbaum, J. V.; Selkirk, T. K.; Otis, F. A., and Mitchell, A. G.: Effects of Diet During Pregnancy on Development of Rickets in the Offspring, J.A.M.A., 87:1973 (Dec. 11) 1926.

trition of the University of Cincinnati. The attempt to make the diets ideal met with varying success. An accurate record was secured of the kinds and amounts of the food actually consumed, and it was found that while the total caloric intake was low in many cases, all of the women received a well-balanced diet with an adequate intake of calcium, phosphorus, iron and vitamins because of the liberal use of milk, fruit and vegetables.

Table 1 gives an illustrative dietary of one of the cases, and Figure 1 is a chart demonstrating graphically the calories and mineral intake during the entire period.

In studying the offspring of these mothers, it was found that the infants developed degrees of rickets which apparently varied according to the caloric intake of the mothers. It was noted that the mothers whose diets were low in total calories gave birth to infants who were less resistant to rickets and showed more marked evidence of the disease.

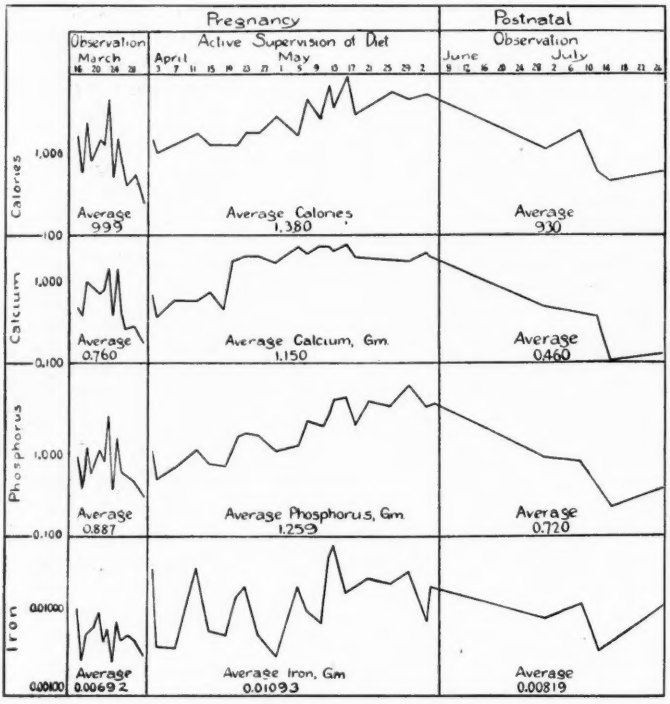

Fig. 1.—Calories and mineral intake in one case studied.

These children received the routine care of the Babies' Milk Fund Association. Some of them were lost from observation after the period of the original study, but thirteen of them have recently been again studied, their ages ranging from 4 years to 4 years and 9 months. These children

were studied by the following methods: physical examination, dental examination, roentgenograms of the jaw, incisor teeth and wrists, and artificial stone models of the teeth.

While much has been written concerning rickets and teeth, and prenatal diet and teeth, we have been unable to find in the literature any observations similar to ours since the advent of modern methods of diagnosing rickets and modern

Fig. 2.—Wrist in Case 18, showing marked rickets in ulna and radius at 7 months.

knowledge of nutrition. There were some studies on the effect of prenatal diet in animals by McCollum and his coworkers[4] and by Edward Mellanby,[5] who found certain changes in the teeth of those offsprings in which rickets had developed. The inference is drawn by these investigators and many others that children's teeth are influenced by the same dietary factors as animal's teeth are, and dental defects are therefore preventable.

There is much confusion on this subject as to the rôle of both prenatal diet and rickets in relation to teeth. Some

Fig. 3.—Wrist in Case 18 at 4 years and 9 months, showing normal condition of ulna and radius.

4. McCollum, E. V.; Simmonds, Nina; Kinney, E. M., and Grieves, C. J.: Relation of Nutrition to Tooth Development and Tooth Preservation, Bull. Johns Hopkins Hospital, 33:202 (June) 1922.

5. Mellanby, Edward: Diet and Disease with Special Reference to the Teeth, Lungs and Prenatal Feeding, Brit. M. J., 1:515 (March 20) 1926.

workers, such as Dick,[6] assign rickets as a cause of dental disease, while May Mellanby and her co-workers,[7] Howe,[8] Brown and Depree[9] and others claim that improper prenatal or postnatal diets, as well as infectious diseases, glandular and nutritional disturbances and poor oral hygiene, are the main causes. Especially is there difficulty in separating the lesions into caries, hypoplasia, malocclusion and other malformations such as odontoclasia (recently described by Simonton and Jones[10]), as it is often assumed that the factors producing hypoplasia will also produce caries. With regard to rickets, Hess[11] makes the clearest statement we have found, namely that "there is no characteristic lesion of the teeth which is distinctive of rickets." This belief apparently is not shared by Dick[12] and other writers. In our group of children, caries, a mild degree of malocclusion and lack of development of the enamel (in only two teeth of one child) were the only pathologic conditions found.

There is also failure to distinguish between the deciduous teeth and the permanent teeth, many workers not stating clearly whether the factors they are studying relate to the deciduous teeth, or to the permanent teeth; although, in human beings, the calcification of the one set is mainly prenatal, and of the other postnatal. Hess also states[13] that the deciduous teeth are not greatly affected by rickets, except for delay in their eruption.

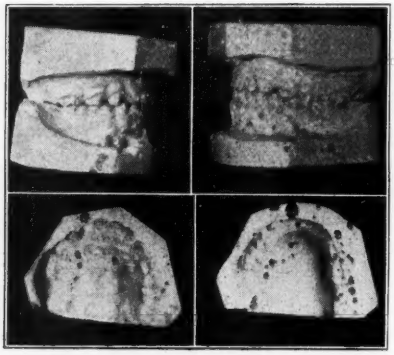

Fig. 4.—Photographs of model, Case 18. Above: Side view. Below: Occlusal view.

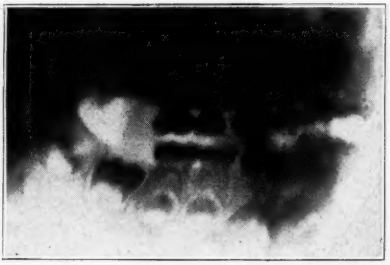

Fig. 5.—Appearance of jaw in Case 18, showing normal deciduous unerupted teeth.

Another confusing factor is injected into the literature when the condition of the teeth of the children with florid

6. Dick, J. L.: Influence of Diet on Dentition, Practitioner, 116:275 (March) 1926.

7. Mellanby, May; Pattison, C. L., and Proud, J. W.: Effect of Diet on Development and Extension of Caries in Teeth of Children, Brit. M. J., 11:354 (Aug.) 1924.

8. Howe, P. R.: Importance of Diet During Prenatal and Infant Life on the Development of Human Teeth, Dent. Cosmos, 70:9 (Jan.) 1928.

9. Brown, J., and Depree, S. B.: Diet, Dentistry and Disease, Practitioner, 110:448 (June) 1924.

10. Simonton, F. V., and Jones, Martha R.: Odontoclasia, J.A.D.A., 14:984 (June) 1927.

11. Hess, A. F.: Rickets, Philadelphia: Lea & Febiger, 1929.

12. Dick, J. L.: Rickets, New York: E. B. Treat & Co., 1922.

13. Hess, A. F.: In Abt, I. A.: Pediatrics, Ed. 1-2; Philadelphia: W. B. Saunders Company, 1923, p. 929.

rickets which has persisted untreated for years is reported. It is evident that such a condition cannot be compared with the study of teeth in children of the same age who had active rickets only during the period of infancy, with subsequent healing. The present study is concerned with the deciduous teeth of a group of children who had shown varying degrees of rickets in the first year of life, but who, at the time of the present examination, showed no evidence of active rickets on clinical study or in roentgenograms of the wrists.

Fig. 6.—Incisor teeth. (Above, Case 18; below, Case 25.)

Photographs of the early and present condition of the same wrists, models of the mouth and roentgenograms of jaw and teeth of one case are shown. (Figs. 2-6.)

Table 2 shows the various factors studied during the prenatal life, during infancy and at the time of the present examinations. All the children were negroes, and they had been breast fed during the first eight months of life.

The analysis and correlation of the condition of the teeth and the various factors relating to prenatal diets and the degree of rickets at 8 months of age are shown in Tables 3-9.

In these children, rickets had little effect in causing subsequent defective occlusion, or caries of the deciduous teeth. Three (26 per cent) of the thirteen cases showed a mild degree of defective occlusion. One (33 per cent) of these three children had mild rickets, while two (66 per cent) had a marked degree of rickets at 8 months. In the ten children with normal occlusion, seven (70 per cent) had mild and three (30 per cent) had a marked degree of rickets at 8 months of age. Of the five children with marked rickets at 8 months, two (40 per cent) had caries and three (60 per cent) had no caries; and in those who showed the mild type of rickets at 8 months, approximately the same percentage of caries was found. In the whole series, 38 per cent of caries was found.

In a control group of (twelve) colored children between 4 and 5 years of age attending the same clinics, the incidence of caries was found to be 66 per cent. Nothing definite is known about the diets of the mothers of these children during pregnancy.

Although we desire to draw no conclusions, we may state that the majority of a small group of children whose mothers' diets during pregnancy were definitely known and who were intensively studied during the first year of life and again at 4½ years of age, were found to have teeth which, in a general way, were satisfactory as far as caries and occlusion were concerned. The number of children is too small to allow analysis of the several factors studied. In the body of the paper, we have also noted all those things such as infectious diseases, season and state of nutrition which might possibly be considered as in-

TABLE 2—ANALYSIS

Case	Sex	Age	Season of Birth	Average Daily Caloric Intake of Mother	Degree of Rickets at 8 Months	Condition of Teeth Clinically	Occlusion
4	F	4 yr. 8 mo.	Winter	1,706	Mild	20 teeth, all normal	Normal
5	F	4 yr. 5 mo.	Summer	1,463	Mild	20 teeth, 8 carious	Normal
9	M	4 yr. 2 mo.	Summer	1,529	Mild	20 teeth, 1 carious	Normal
10	M	4 yr. 8 mo.	Winter	1,524	Marked	20 teeth, 4 carious molars	End-to-end bite
11	M	4 yr. 9 mo.	Winter	1,521	Mild	20 teeth, all normal	Marked distal occlusion
14A	F	4 yr. 8 mo.	Winter	1,969	Mild	20 teeth, all normal	Normal
14B	F	4 yr. 8 mo.	Winter	1,969	Mild	20 teeth, all normal	Normal
15	F	4 yr.	Summer	1,995	Marked at 20 months	20 teeth, 8 carious	Open bite
17	F	4 yr. 8 mo.	Winter	2,023	None at 8 months; none at 24 months; x-ray negative; clinically mild type	19 teeth, one tooth knocked out, lack of enamel development of two upper molars	Normal, upper left central incisor missing
18	M	4 yr. 9 mo.	Summer	1,380	Marked	20 teeth, all normal	Normal
21	F	4 yr. 8 mo.	Winter	1,500	Marked	20 teeth, all normal	Normal
23	F	4 yr. 8 mo.	Winter	1,400	Mild	18 teeth, seven carious, two missing molars	Normal, two molars missing
25	M	4 yr. 1 mo.	Summer	1,449	Marked	20 teeth, all normal	Normal

*The roentgenogram of the wrist reveals no rickets in any case at the present time.

OF CASES*

Condition of Mother During Pregnancy	Condition of Child	Nutrition	Posture	Roentgen-Ray Appearance of Jaw	Roentgen-Ray Appearance of Incisors	Arch
Early nausea, well thereafter	Measles, colds, tonsillectomy	Fair	Good	Normal	Normal	Normal, wide, flat
Well	Mumps, pneumonia		Good	Caries of deciduous teeth	Normal	Normal
Well	Pertussis	Good	Abdomen large	Normal second bicuspid bud missing	Normal	Narrow, V-shaped, high
Well	Colds, mouth breather (snores)	Poor	Poor, scoliosis, bow legs, left shoulder high	Normal	Normal	Short anteroposteriorly, normal in width
Well	Measles, chicken pox, pertussis, thumb and finger sucker	Fair	Good	Decalcified area in unerupted first permanent molar	Decalcified uneruped incisors, slightly notched	Narrow, high
Vomited first 3 months, well thereafter	Measles, chicken pox, pertussis, colds, tonsillectomy	Good	Good	Normal	Normal	V-type, normal
Vomited first 3 months, well thereafter	Measles, chicken pox, pertussis, colds, tonsillectomy	Good	Good	Normal	Normal	Normal
Well	Measles, pertussis, sucks two fingers	Good	Good	Retarded development of unerupted bicuspid	Normal	Narrow, normal arch
Vomited first 3 months, well thereafter except for one cold	Measles, chicken pox, pertussis, colds, sucks lips	Fair	Abdomen large	Normal	Notched unerupted central incisors	Normal
Well	Measles, chicken pox, mumps, pneumonia, thumb sucker to 1 year of age	Good	Good	Normal	Normal	Normal
Syphilitic treatment throughout pregnancy, cough with vomiting once a month	Well, no diseases, sucks tongue	Good	Good	Normal	Notched upper unerupted incisors	Normal, wide and flat
Vominted first 4 months, sick most of time thereafter	Measles, chicken pox, pertussis, sucks thumb, mouth breather	Good	Good	Normal except two bicuspid buds missing, deciduous teeth missing	Normal	Narrow, high
Well	Measles, tonsillectomy	Good	Good	Normal retarded, unerupted buds	Normal	Normal

fluencing dentition. Perhaps the most interesting observation is in regard to the diet of the mother during pregnancy and its relation to the deciduous teeth. It is shown that in only one (20 per cent) of five children who developed caries was the mother's diet during pregnancy adequate in caloric intake. In the case of eight children without caries, four (50 per cent) of the mothers had a diet which was calorically adequate, and in the other cases (50 per cent) of children whose teeth were not carious, the mothers' diets were calorically deficient. Similarly, it is shown that in only one (33 per cent) of the three children with defective occlusion was the mother's diet during pregnancy adequate in caloric intake; while of the ten children with normal occlusion, the diets of four (40 per cent) of the mothers were adequate, and in the remaining six mothers (60 per cent), the diets were calorically deficient. The teeth of this group of children were, in general, excellent, and it is significant

TABLE 3.—RELATION OF CALORIC INTAKE DURING PREGNANCY TO THE DECIDUOUS TEETH

Case	Daily Caloric Intake	Teeth
	Type I Diet	
18	1,380	Normal
23	1,400	Caries
25	1,449	Normal
5	1,463	Caries
21	1,500	Normal
	Type II Diet	
11	1,521	Defective occlusion
10	1,524	Caries and defective occlusion
9	1,529	Caries
	Type III Diet	
14 A	1,969	Normal
14 B	1,969	Normal
15	1,995	Caries and defective occlusion
17	2,023	Defective enamel of two upper molars

*The diets are represented as follows: Type I, below 1,500 calories daily; Type II, between 1,500 and 1,700 calories daily; Type III, over 1,700 calories daily.

TABLE 4.—COMPARISON OF CHILDREN SHOWING PRESENCE OR ABSENCE OF CARIES WITH DEGREE OF RICKETS AT 8 MONTHS

	Mild Rickets at 8 Months	Marked Rickets 8 Months
Children with Caries	3	2
Children Without Caries	5	3

TABLE 5.—COMPARISON OF CHILDREN SHOWING PRESENCE OR ABSENCE OF CARIES WITH TYPES OF PRENATAL DIET

	Type I Diet	Type II Diet	Type III Diet
Children with Caries	2	2	1
Children Without Caries	3	1	4

TABLE 6.—COMPARISON OF CHILDREN WITH DEFECTIVE OCCLUSION AND DEGREE OF RICKETS AT 8 MONTHS

	Mild Rickets at 8 Months	Marked Rickets at 8 Months
Children with Defective Occlusion	1	2
Children with Normal Occlusion	7	3

TABLE 7.—COMPARISON OF CHILDREN WITH NORMAL AND DEFECTIVE OCCLUSION AND TYPE OF PRENATAL DIET

	Type I Diet	Type II Diet	Type III Diet
Children with Defective Occlusion	0	2	1
Children with Normal Occlusion	5	1	4

TABLE 8.—COMPARISON OF CHILDREN WITH NORMAL AND HIGH PALATAL ARCH AND DEGREE OF RICKETS AT 8 MONTHS

	Mild Rickets at 8 Months	Marked Rickets at 8 Months
Children with High Arch	3	0
Children with Normal Arch	5	5

that they were born of a group of mothers all of whose diets were experimentally regulated and balanced during the later half of pregnancy, so that, although deficient in caloric value, the mineral and vitamin content were adequate. We feel from our own work and a study of the literature that there is yet lacking definite proof of the effect of prenatal diet on teeth in the human offspring, although theoretical consideration and animal experimentation would argue for similar effect.

TABLE 9.—COMPARISON OF CHILDREN WITH NORMAL AND HIGH PALATAL ARCH AND TYPE OF PRENATAL DIET

Children with High Arch	Type I Diet	Type II Diet	Type III Diet
3	1	2	0
Children with Normal Arch			
10	4	1	5

DISCUSSION

Henry Klein, Baltimore, Md.: The question of the relation of prenatal diet to the incidence of dental defects in both the deciduous and the permanent dentition is one which is taking up the major portion of our interests. Previous experimental work concerning the subject under discussion is meager. The determination of the effects of prenatal diet on the incidence of dental defects is one which is very difficult when human beings are used as the experimental subjects, because rigid experimental control of the many variables involved is almost impossible. This, of course, affects profoundly whatever conclusions one may draw from the work with human beings. For this reason, swine have been selected as the experimental animal for the determination of the effects of prenatal diet on tooth structure. Dr. Greenebaum's statement that the characteristic sign of rickets is delayed eruption of the teeth is to be considered not quite complete. In addition to this frequently observed phenomenon, histologic examination of the uneruptured tooth germs indicates a profound effect on these structures, of which the predominant effect is extreme hypoplasia of the enamel. William Bauer has shown, in the case of a human baby which came to necropsy, that the characteristic lesion in the tooth germ was extreme hypoplasia of the enamel. Bauer,[14] in addition, notes a swelling of the ganoblasts or ameloblasts. This he characterizes as the balloon-like degeneration of the ameloblasts. He states further that, in rickets, the presence of such balloon-like degeneration of the ameloblasts is characteristic of the developing rachitic tooth. In addition, he states that the hypoplasia of the enamel is due to the fact that the absence of the essential food element responsible for the rachitic condition has so affected the metabolism of the ameloblasts as to disturb their function to such an extent that they become swollen and cease functioning, and, in this way, are unable to lay down enamel, this accounting for the hypoplastic areas. Whether or not the latter conclusion as to the nature of the injury of the ameloblasts is true or not is open to question. Such balloon-like swelling may be due possibly to postmortem changes, and since the conclusions of Bauer are based upon such a small number of specimens, they are to be questioned until substantiated. In our own work with a large number of pigs, we too have observed similar phenomenon in the tooth germ, further details and further discussion of which will appear in an early publication. Delayed eruption of the teeth may be considered an early clinical sign of rickets. I should like to ask Dr. Greenebaum whether or not he determined the actual amount of calcium and phosphorus in the blood of pregnant women. This is of greater significance to the clinical picture than any determination of calcium and phosphorus intake. In this connection, I should like to call to Dr. Greenebaum's attention the work of Kramer and Howland of the Johns Hopkins Hospital.

Dr. Greenebaum (closing): Dr. Mellanby, in his studies, showed defects of the teeth in microscopic sections, even though the teeth appeared normal to the average practitioner. It apparently is impossible to diagnose a rachitic condition of the teeth by local examination. In regard to the question concerning blood calcium: I have one of my original reprints here to give you. We not only made blood calcium determinations on the mothers and babies, but also phosphorus and calcium determinations on the breast milk.

14. Bauer, William: Vierteljahrsschr. f. Zahnheilk. No. 1, 1929, p. 62.

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C. N. JOHNSON, Editor

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Editorials

WANTED—A NEW SPIRIT

We hear much these days about the pressing needs of our profession: the need of improved denture construction, the need of better control of the expansion and contraction problems in cast inlay work, the need of a more reliable root-canal filling, the need of a better dentifrice and, above all, the need of a deeper understanding of economics as it relates to the practice of dentistry.

Doubtless, all of these and many more of our practical matters stand in need of improvement, and the members of the profession should not cease in their efforts until these various reforms have been brought about.

But the thing of all others that stands out and cries most insistently for recognition is a regeneration of the professional spirit that made of dentistry what it is. It should always be remembered that the best traditions of dentistry have not been built by a concentration on the material things of the profession, by excellence of craftsmanship or ingenuity of technic. Alluring and commendable

as these things are, they have not given a professional status to dentistry. A profession without a soul is at best only a refined trade, and, say what we will, there is something about professional life that transcends the best there is in tradesmanship. And it is this tendency to tradesmanship and commercialism today that threatens the very foundations of our calling. The dominant spirit of the present age is not the one that built dentistry and made of it a real profession; it was then the spirit of self-sacrifice and self-abnegation—the spirit that impelled the founders of the first dental periodical to go into their pockets and support it by very generous personal contributions. In an age when the profession was struggling in its swaddling clothes, these splendid men contributed liberally to a fund to pay the cost of publication in order that dentistry might have a mouthpiece. How many of our men today would do that?

There are still those who make sacrifices for their profession, but the percentage is not so great today as it was in the early days, nor is the dominant spirit of professionalism as pronounced. Today, there crops out all along the line a tendency toward commercialism; a tendency constantly to keep an eye on the main chance; to seek to gain an advantage; to take instead of to give. We need a sane study of economics in our profession, a more orderly way of conducting our material affairs, but we do not need to sell our professional birthright for a mess of material pottage.

And it is not only the young men who are at fault, though some of them seem to learn this lesson of commercialism very early in their career. We cannot expect the young practitioner to come at once into the kingdom of true professionalism. Most recent graduates have taken up dentistry as a means of earning a living and gaining a position in polite society. There is, quite naturally, a material tinge to their point of view; and this materialism is not confined to dental graduates; it is found in the medical graduate as well, and, in fact, in the graduates of all professional schools. How could it be otherwise? True professionalism is gained only in the alembic of a hard and sometimes trying practical experience. No young dentist ever comes to realize the fullness of his profes-

sional obligation, nor does he actually taste the sweets of professional reward, till he has encountered the drawn and tortured face of agony and has been able by his ministrations to relieve the suffering. There is no reward of professional life—surely no reward of a material kind—that can ever equal that of looking into a human countenance and seeing the tense and stressful lines relax and the drooping eyelids close in blessed sleep after prolonged and racking pain. Call it banal or what you will, but there is something very real and very satisfying in having acquired the ability to control and eliminate pain and in being given the privilege of doing this; and the young dentist who comes into this realization has his first taste of what is meant by sanctified service. Not till he has experienced this is he a professional man in the true sense, and not till then does he ever catch a glimpse of the real spirit which goes to make up the best of professional life.

And it is an apparent lack of this spirit at the present time that forms the burden of our theme. We need an infusion of the old time idea that was most apparent in some of our pioneers, the idea that every man owes to his profession a certain amount of self-sacrifice; that he does not practice it for gain alone, and that while every man is worthy of his hire, the best recompense of professional life comes not from the money he makes, but from the service he renders. Without a certain amount of sentiment and altruism, professional life becomes as barren as a burned-over forest, with all of the luxuriance and life taken out of it. It is "sounding brass and a tinkling cymbal," with nothing substantial or generous or attractive or sublime about it. If we are to keep selfishness and sordidness out of our profession and face the people with a clear conscience, we must dedicate ourselves to a new consecration and a new spirit; and this will come only as we realize the actual obligation we assumed when we elected to become professional men and women.

DENTIFRICE ADVERTISING AND THE PROFESSION

From time to time, protests, either by individuals or by groups of dentists, have been made against the exploitation of dentifrices

with unwarranted and misleading claims. But in spite of the plea for more honesty in the advertising of dentifrices, the sales of which in the United States alone last year amounted to $60,000,000, there still is to be found objectionable advertising, that is, just enough truth interwoven with unwarranted assertions to confuse the lay reader. Many of these advertisements frankly are intended to scare the lay reader into using a particular toothpaste. The advertising claims range all the way from neutralizing "acid mouth" and checking bacteriologic growth, to guarding against systemic infection.

To the mind of the discerning reader, the implications of these advertisements serve as food for thought. Naturally, the first thing about a dentifrice that comes to mind is a complete knowledge of the composition. Suffice it to say, many of the dentifrices on the market are secret or semisecret in composition. Unless the user, including the dentist, has information regarding their composition, there is no way of judging the claims without extensive and time-consuming experiment. It follows that the dentist must have this information if he is to answer intelligently the question, "Doctor, what toothpaste do you recommend?"

But a knowledge of the composition is not enough. If claims other than those regarding the cleansing character of the dentifrice are made, the dentist must be satisfied that the claims are justified by adequately controlled scientific data. In addition, he wishes to be convinced that there is nothing of an abrasive or harmful nature in the product.

The recent formation of the Council on Dental Therapeutics offers an obvious solution to this perplexing problem. No doubt, the Council, in the very near future, will offer an authoritative answer to the question as to what may be expected of dentifrices. Not only forward-looking dentists, but also forward-looking manufacturers and advertisers, will welcome the actions of the Council in this regard. It cannot be repeated too often, that a dentifrice can serve no other useful purpose than to develop clean habits in caring for the mouth, and that false or misleading claims as to its

virtues are calculated to do harm both to the profession and to the public.

MAY DAY FOR CHILDREN

The American Child Health Association in organizing May Day had in mind the idea of concentrating on child health for the better conservation of the children of the nation. May Day has become really an annual institution and every agency should be employed to further this idea. The slogan this year is a most worthy one—"Every Parent and Every Community United for Health for Every Child." The significance of child health is becoming more and more apparent to welfare workers all over the world, and this May Day idea is intended to crystallize the thought of the people on the problem of child conservation. It is a concrete expression of the concept contained in the well known "Child's Bill of Rights," formulated by Herbert Hoover:

> The ideal to which we should strive is that there shall be no child in America:
> That has not been born under proper conditions
> That does not live in hygienic surroundings
> That ever suffers from undernourishment
> That does not have prompt and efficient medical attention and inspection
> That does not receive primary instruction in the elements of hygiene and good health
> That has not the complete birthright of a sound mind in a sound body
> That has not the encouragement to express in fullest measure the spirit within which is the final endowment of every human being.

This bill of rights cannot be repeated too often. It should be incorporated in the program of every child health activity, and should form the basis of every child reform.

The dental profession should take a keen interest in May Day. Around the May pole, one of the streamers emphasizes the need for periodical inspection of the teeth by the professional man, and linked up with the idea of May Day are all of those agencies which are calculated to foster child welfare.

In the past, more systematic attention was given by government authorities to the raising of domestic animals than to the

rearing of children, but, in recent times, it has begun to dawn on officials and welfare workers that our greatest asset is good health, physical and mental, of our growing children. All of these agencies that have been organized for the conservation of childhood are entitled to the hearty support of thinking people everywhere, and the dental profession can do itself justice in no better way than by getting loyally behind the child health standard and assisting by every means in its power.

Look forward to May Day (May 1, 1930) and foster its ideals in every way possible.

THREE DISTINCT SERVICES

There seems to be some confusion about the service in the Central Office in certain departments. There are three distinct, though allied, bureaus each with a different function. There is the Bureau of Dental Health Education, organized to assist in promoting mouth hygiene among the profession and the laity by suitable literature, moving pictures, lantern slides, posters, etc. There is the Library Bureau, serving the profession by the loan of books and particularly of package libraries, by means of which our members may gain access to current literature on the different subjects of interest to the profession. There is the Bureau of Chemistry, designed to investigate and report on the various preparations offered the profession and the public in the way of mouth washes, pyorrhea remedies and other similar products.

These three bureaus are located at the Central Office, 58 East Washington Street, Chicago, Ill., and should be so addressed. It will expedite matters if our members will bear the foregoing information in mind and proceed accordingly.

COUNCIL ON DENTAL THERAPEUTICS

OFFICIAL RULES OF THE COUNCIL ON DENTAL THERAPEUTICS

The Council on Dental Therapeutics has adopted the following official rules and form for the presentation of articles for consideration by the Council. Explanatory comments on the rules may be obtained by addressing the Secretary of the Council on Dental Therapeutics, American Dental Association, 58 E. Washington St., Chicago, Ill.

SAMUEL M. GORDON, *Secretary.*

INTRODUCTION

The following rules have been adopted by the Council primarily with the object of protecting the dental profession and the public against fraud or imposition, undesirable secrecy and objectionable advertising in connection with the marketing of proprietary dental articles.

The list Accepted Nonofficial Dental Remedies shall contain a description of proprietary articles which have been accepted as conforming to the rules of the Council; of such simple nonproprietary and nonofficial substances as seem to be of sufficient importance to warrant their inclusion, and of simple pharmaceutic preparations the inclusion of which is believed to give useful information to dentists.

It is anticipated that later on the Council will be in a position to consider ceramic and metallurgic articles and physical therapy apparatus. Suitable announcement will be made when these items are taken up for consideration.

For admission to A. N. D. R., proprietary pharmaceutic mixtures must comply with the rules, and, to determine such compliance, they will be investigated by the Council. The Council endorses the principle that dental preparations, excepting dentifrices, should be prescribed and used on the basis of therapeutic effects of the individual ingredients. For this reason, it includes in this list only those mixtures that present some real advantage.

Dentifrices (with special reference to those advertised to the public) may be accepted for inclusion in the list of Accepted Nonofficial Dental Remedies provided: claims are strictly limited to oral hygiene purposes; no therapeutic, chemical or bacteriologic claims are made or inferred in their exploitation; therapeutically suggestive names are not used as a brand name; the brand name is not indicative of a component which does not possess proven therapeutic properties or other inferred properties implied in the name, and there is no conflict with the rules of the Council. The provisions in reference to proprietary names will not be retroactive.

RULES GOVERNING THE ADMISSION OF PROPRIETARY ARTICLES TO THE LIST, "ACCEPTED NONOFFICIAL DENTAL REMEDIES."

The term "proprietary article" in this place shall mean any chemical, drug or similar preparation used in the treatment of diseases, if such article is protected

against free competition, as to name, product, composition or process of manufacture, by secrecy, patent, copyright or by any other means.

Rule 1. *Composition.*—No article will be accepted for inclusion in the list, Accepted Nonofficial Dental Remedies, or retained therein, unless its composition is published. For simple substances, the scientific name and the chemical formula, rational or structural, if known, should be supplied. For mixtures, the amount of each active medicinal ingredient in a given quantity of the article must be stated. The general composition of the vehicle, its alcoholic percentage and the identity of the preservatives must be furnished.

Rule 2. *Identification.*—No article will be accepted or retained unless suitable tests for determining its composition are furnished to the Council. In the case of chemical compounds, these shall consist of tests for identity and purity. In the case of mixtures, description of methods for determining the amount and active strength of the potent or otherwise important ingredients shall be furnished if practicable.

Rule 3. *Direct Advertising.*—No article that is advertised to the public will be accepted or retained, but this rule shall not apply to *(a)* disinfectants, germicides and antiseptics, provided the advertising is limited to conservative recommendations for their use for oral hygiene purposes; and provided they are not advertised as curative agents, either directly or inferentially; *(b)* dentifrices (tooth pastes and powders) which act as mechanical agents in the cleaning of the teeth; provided, of course, no such agent is known to contain harmful materials and none of the lay advertising is contrary to the Council's attitude on dentifrices; *(c)* other prophylactic agents about which the public should be informed which would not lead to harmful self-medication provided (1) they are not advertised as curative agents and provided (2) advertising does not go beyond that passed by the Council for dentists (Rule 6); and *(d)* medicinal foods, except when advertised as curative agents.

Rule 4. *Indirect Advertising.*—No article will be accepted or retained if the label, package or circular accompanying the package contains the names of diseases or conditions in the treatment of which the article is said to be indicated. The therapeutic indications and properties may be stated, provided such statements do not suggest self-medication. Dosage may be indicated. (This rule shall not apply to remedies with which self-medication is altogether improbable.)

Rule 5. *False Claims as to Origin.*—No article will be accepted or retained concerning which the manufacturer or his agents make false or misleading statements as to source, raw material from which made or method of preparation.

Rule 6. *Unwarranted Therapeutic Claims.*—No article will be accepted or retained concerning which the manufacturer or his agents make unwarranted, exaggerated or misleading statements as to the therapeutic value.

Rule 7. *Poisonous Substances.*—The principal label on an article containing "poisonous" or "potent" substances must state plainly the amount of each of such ingredients in a given quantity of the product.

Rule 8. *Objectionable Names.*—Proprietary names for medicinal or dental articles coming within the scope of this Council will be recognized only when the Council shall deem the use of such exclusive names to be in the interest of public

welfare. Names which are misleading or which suggest diseases, pathologic conditions or therapeutic indications will not be recognized. In the case of pharmaceutic preparations or mixtures, the name must be so framed as to indicate clearly the most potent ingredients. In the case of dentifrices, the Council's attitude on mixtures will guide the Council in the interpretation of this rule.

Rule 9. *Products with Protected Names.*—If the article is patented—either process or product, or both—the number of such patent or patents much be furnished to the Council. Furthermore, if the name of an article is registered or the label copyrighted, the registration (trademark) number and a copy of the protected label should be furnished the Council. In case of registration in foreign countries, the name under which the article is registered should be supplied.

In the case of dentifrices, the provisions of the Council's attitude on mixtures will guide the Council in the retention of a dentifrice marketed under a protected name.

Rule 10. *Unscientific and Useless Articles.*—No article will be accepted or retained which, because of its unscientific composition, is useless or inimical to the best interests of the public or of the dental profession.

FORM FOR THE PRESENTATION OF ARTICLES

Any article which it is desired to have considered for inclusion in Accepted Nonofficial Dental Remedies should be presented to the Council on Dental Therapeutics, Samuel M. Gordon, Secretary, 58 E. Washington St., Chicago, and, except in special instances, should be accompanied by:

(a) Three original packages of the article as it is supplied to the trade.

(b) Fifteen copies of each advertising circular, pamphlet, booklet, etc., which is used to promote the sale of the product. If such circulars are included with trade packages or distributed to the public, this should be noted on the circular or circulars so distributed.

(c) A description of the article in general accord with the outline which follows.

The "description" is requested to facilitate the work of the Council in determining whether or not an article complies with the rules governing the admission of articles to Accepted Nonofficial Dental Remedies. To a considerable extent, it is used also to prepare the description of the accepted article for publication in the columns of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION. It is, therefore, requested that the statements be made exact, clear and concise, and in accord with the following numbered headings. The description should be complete in itself and should not require reference to price lists, catalogs, etc.

1. Name.—The name or the trade name of the article.

2. Synonyms.—Title to be used in prescribing or purchasing, and synonyms, if any. (See Rule 7.)

3. Definition.—*(a)* If the article is a definite substance, its scientific name and its chemical formula, preferably structural or rational. (See Rule 1.)

(b) If the article is a mixture, a statement of the amount of its active medicinal

ingredients in a given quantity, preferably in the percentage form, and in general accord with the statement of quantities as followed in the United States Pharmacopeia; also the general composition of the vehicle, its alcoholic percentage, if any, and the identity of preservatives if present. (See Rule 1.)

4. Preparation.—A general statement of the process of manufacturer. The Council does not wish to know the details of manufacturing methods, but only a general outline as an aid in verifying the nature and composition of an article. For ordinary pharmaceutic mixtures, the process of preparation is not required. When it is difficult to prove the identity of composition of an article by chemical tests, an outline of the manufacturing process may be essential.

5. Properties.—Appearance, odor, taste, etc.; if a definite chemical, also the melting point, boiling point, solubility, etc.; important incompatibilities.

6. Tests.—*(a)* If a chemical substance, tests of identity, purity and strength should be furnished. (See Rule 2.)

(b) If a mixture, a method for the identification and estimation of the chief constituents, as far as practicable, is desired.

7. Pharmacologic Action.—A brief statement of the medicinal properties which the article is claimed to possess.

8. Therapeutic Indications.—A brief statement of the conditions and diseases in which the article is claimed to be indicated.

9. Dosage.

10. Manufacturer.

11. Patents and Trademarks.—Number of U. S. patent and number of patent in country of origin; number of U. S. trademark. If the article is registered in foreign countries, the name under which it is registered should be furnished. (See Rule 9.)

ACCEPTED NONOFFICIAL DENTAL REMEDIES

Reports on products which have been considered by the Council and have been found to conform to the rules of the Council, may be published in THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION under the section devoted to the Council on Dental Therapeutics with a special heading, "Accepted Nonofficial Dental Remedies."

It is anticipated at the end of a certain period to assemble all the reports in book form. This book shall have the title, "Accepted Nonofficial Dental Remedies."

After the acceptance of a product by the Council and as long as the product conforms to the rules, the manufacturer of any product may affix to the name of the product the letters "A. N. D. R." as indicating a product acceptable to this Council.

BUREAU OF DENTAL HEALTH EDUCATION

CALCIUM FIXATION*

By PERCY R. HOWE, A.B., D.D.S., D.Sc., Boston, Mass.

THERE is no subject that, to my knowledge, has been studied more, and has been more often dropped, than that of calcification, which, I take it, means calcium fixation.

The majority of students of the subject believe that the actual act of calcification is performed by the osteoblast, or, in the case of dentin, by the odontoblast, which is merely a specialized bone cell.

Chemistry has dealt with various steps in the processes involved in the resolution of the salts found in food into bone, dentin or other calcified tissues. Here and there, facts have been obtained which throw a possible or partial light on the process. Yet the whole problem remains obscure.

Calcium intake and calcium retention from the food mass has been studied considerably under various modifying influences, without very definite results. The association of calcium retention with the fat intake has received an unusual amount of investigation.

The idea of Oskar Koltz and others that calcium is best absorbed as a soap is not so firmly held as it once was, although many still believe that the retention of calcium occurs most readily when a considerable amount of fat is present in the diet. Holt-Courtney and Fales came to this conclusion as a result of their studies. Since this condition seems to vary with the type of fat given, and, in the light of more recent studies on the vitamin content of fat, and again since the vitamins of some fats have been demonstrated as specific calcifying agents, it may be that the vitamin is the determining factor.

The studies on rickets indicate a relationship between calcium and phosphorus that, within fairly definite proportion, needs to be maintained for the best storage of calcium. This is usually estimated as being two of calcium to one of phosphorus.

The acid-base ash of foods has also received attention in this connection. Some hold that this is of no especial account; others, that it is an important consideration. My associate, Dr. Logan, carried out some experiments to ascertain the truth regarding the matter. He found that carnivorous animals tolerated considerable amounts of acid with no calcium loss. These animals make more ammonia, which neutralizes the acid. With herbivorous animals, including the monkey, the effect is quite the opposite. When an appreciable amount of acid is fed these animals, a distinct calcium loss occurs. Of the three acids, sulphuric, hydro-

*Read before the Section on Mouth Hygiene at the Midwinter Clinic of the Chicago Dental Society, Jan. 14, 1930.

chloric and phosphoric, the last mentioned caused the greatest loss.

We carried out other experiments and found that the calcium is absorbed and excreted in the small intestine along with the *succus entericus*. We found no excretion into the colon direct, contrary to the usual opinion.

In what form the calcium is taken into the body proper, we can only conjecture, but it seems reasonable to infer that the most complete absorption can occur only when the walls of the small intestine are in a state of health. Nor is it known in what form the calcium exists in the blood. H. Gideon Wells reviewed this matter carefully in his Harvey lecture on calcification, but came to no certain conclusion.

We have heard much of diffusible or ionic calcium in the blood as against nondiffusible calcium. The tests used for this study are of such a questionable nature that accurate determinations are as yet an impossibility. It does seem that blood calcium is fairly stable and that the nondiffusible calcium may become diffusible in case the diffusible calcium reaches a low point. As a rule, the calcium content of the blood seems to be maintained by a withdrawal of calcium from the bones or teeth. Should the regulating system fail to act sufficiently well, tetany occurs. The administration of parathyroid extract to bring up the blood calcium seems to do so at the expense of the bones and teeth. It can be said only that blood chemistry offers an interesting field for future study.

About the actual act of calcification, practically nothing is known, but we do know one or two ways in which it may be induced. This has come about through vitamin experimentation.

The C vitamin, the antiscorbutic factor, acts specifically in causing osteoblasts and odontoblasts to lay down bone or dentin. In the case of a deficiency of this factor, these cells cease to lay down their respective calcified structures, and resorption or liquefaction of the formed bone or dentin occurs. Curiously enough, the first detectable signs of this deficiency are to be observed in the teeth or on the odontoblasts. What the antiscorbutic substance is is unknown, and although we may say that its action seems to be to incite the cells to create intercellular substance, this process being one of jelling or setting of a liquid material, no specific light is thrown on the chemical process of calcification.

The D vitamin also causes calcification to proceed in forming bone or in rachitic conditions. Here, the process is somewhat different, for rickets is in reality a cartilage problem. The cartilage, in forming bone, does not degenerate; consequently, the blood vessels do not enter the cartilage field, and calcification does not proceed. When some substance containing the D vitamin is administered, the cartilage in the forming bones of rats or dogs begins to degenerate, and in three or four days, the blood vessels enter the zone and the osteoblasts begin their work of laying down calcium.

It has been determined that the especial chemical substance which is associated with the D vitamin is ergosterol. This substance, when it is isolated in a purified state, possesses no calcifying property, but when it is subjected to irradiation by ultraviolet light of a given strength, at a given distance and for a given length of time, it takes on calcifying properties estimated to be 200,000 times greater than that of cod-liver oil.

At one time, it was thought that vitamin A played a part in calcification, but it was later found that this was because the A and D vitamins had been confused.

In the case of a deficiency of the A vitamin, the odontoblasts revert to the bone-forming stage and lay down bone instead of dentin in teeth.

While the facts concerning calcification are few, they are of practical importance, since it has been possible to demonstrate certain actions by means of animal experimentation that directly relate to the teeth and bones. It has been shown that the dentin of the teeth is but modified bone, although the exposed part is covered with a highly mineralized keratin substance which we call enamel.

The circulation, which influences nutrition, has been found to be fairly active in dentin, although it is capillary in character.

Through experimental studies, the views which have been held regarding the teeth have undergone considerable modification, and we are beginning to consider dental maladies from a biologic rather than a bacterial standpoint, and to believe that the principles of calcification have a direct bearing on tooth integrity and tooth destruction.

DIETARY CONTROL OF DENTAL CARIES*

By CHARLES L. DRAIN, D.D.S., and JULIAN D. BOYD, M.D., Iowa City, Iowa

THE problem of prevention in dentistry is of universal interest and importance. The orthodontist has long recognized the value of prevention in the treatment of malocclusion; the periodontist has pointed out that early control and prevention are fundamental in the treatment of periodontal disease. Whenever we read any comprehensive discourse on focal infection or root-canal therapy, in the final analysis the author concludes that prevention is the only means of salvation.

Dental caries has been repeatedly regarded as the most widespread of all diseases. Its prevention or early control would solve many of our perplexing problems. The association of caries with the periods of childhood, pregnancy, lactation and debilitating disease leads us to consider its dependence on metabolism.

In previous articles,[1] we have reported the arrest and control of dental caries. To review this work: These observations were made over a period of nearly five years in the Dental Clinic of the Children's Hospital and Children's Clinic, the College of Dentistry, State University of Iowa. In the course of repeated routine examinations of patients, numerous cases of a definite arrest of caries were noted. The dentin, which on previous examinations had been soft, easily probed and easily dislodged, would become hard and impervious even to the sharpest of ex-

*From the College of Dentistry and the Department of Pediatrics, State University of Iowa.

*Read before the Section on Mouth Hygiene at the Midwinter Clinic of the Chicago Dental Society, Jan. 13, 1930.

1. Boyd, J. D., and Drain, C. L.: Arrest of Dental Caries in Childhood, J.A.M.A., 90: 1867 (June 9) 1928; Boyd, J. D., Drain, C. L., and Nelson, Martha: Dietary Control of Dental Caries, Am. J. Dis. Child., 38:721 (Oct.) 1929.

plorers. Open cavities showed no signs of activity months after they had first been described. Many cavities first recorded in 1925 are still open with no progress since the caries was arrested. In all cases to be observed, at least one cavity is left untouched, and in no case are these cavities cleaned of débris or areas of soft caries. Salivary calculus was almost universally present on these teeth, occurring in varying degrees, usually on the lingual surfaces of lower incisors and the buccal of upper molars, irrespective of age. In a few cases, deposits were very heavy, occurring on the labial as well as lingual surfaces of incisors. While salivary calculus deposits are not uncommon in the adult, it is very unusual in the child, especially the young one. Otherwise, these patients showed nothing noteworthy from the dental standpoint. Dentition was about normal in all cases and the degree of oral hygiene varied as greatly as in any unselected group of similar size. Some teeth showing unquestionable arrest of caries were found in the most poorly kept mouths.

When these first findings were correlated with the medical histories, it was found that, without exception, these patients fell into a certain class of patients who had been under careful management for six months or more for their medical condition, diabetes. The diabetes itself does not offer an explanation of the arrested caries. A review of earlier examinations revealed that most of these patients at the time of their first coming to the hospital showed definitely active caries; and, furthermore, that diabetics not under control have a negative mineral balance, which of necessity must lead to decalcification of the teeth.

Since arrest of caries was not noted in any other group, and since it is not dependent on diabetes itself, it appeared that it must depend on some factor in the management of the disease. A further study reveals a parallelism between the establishment of diabetic control and the quiescence of caries.

The question was raised as to whether arrest of caries was to be explained on the basis of some of the departures from normal diet, since the diabetic diets used in the hospital furnish 70 per cent of the calories with fat, rather than the adequacy of the diet. The question as to the possible effect of insulin was also raised.

In order to answer this, a group of nondiabetic children were selected, and placed on diets similar to those given the diabetic children. No insulin was given. Four patients were on this routine diet for two months or longer. In every instance, caries was arrested.

It was possible to follow the subsequent course of two of these patients after they had returned to the ward routine. During the several months they remained in the hospital after the observation period, the regular ward diet was offered them. While ward menus are designed to meet fully the child's needs, intake was not stressed and, as a result, these children chose from the foods offered those most pleasing to them, refusing the remainder. After several months, both cases were found again to show active caries, one patient having three new cavities.

We next wished to determine whether caries could be controlled in the home, under parental supervision. A group of preschool children was selected and the cooperation of several parents was obtained. Five children followed the routine until caries was completely arrested. In no case did it require more than ten weeks, and with one exception, a child who developed otitis media the second

week of the control, all gained weight consistently, three at the rate of one-half pound each week.

Another group studied was that of four little girls with celiac disease, a condition in which the ability to absorb fat and starch is impaired, necessitating the use of simple sugars and proteins as sources of nutrition. The disease is always described clinically as being accompanied by severe carious destruction of the teeth.

The two older children had extensive caries, when first seen; the two younger ones, 25 and 31 months respectively, had not yet developed cavities. This group have been seen irregularly for over three years, and during that time, have been under dietary management for their condition. The two younger patients have not developed any cavities and the caries of the older ones was arrested as in the other conditions discussed.

We have, therefore, in four distinct groups under divergent conditions arrested and controlled dental caries by dietary management. Correlating the diets of these four groups, we find that while they are in many respects widely different, each seems equally effective in arresting caries. In one, calories were supplied principally as simple sugars and fats avoided as much as possible; in another, fats furnished most of the energy, and only enough carbohydrates were used to make the diet antiketogenic. It will be noted that in many essentials the diets were very similar. Each child received, every day, cod-liver oil, milk, orange or tomato juice, fruits and vegetables, in amounts designed to meet the requirements for vitamins and minerals. Whatever the factors essential for tooth integrity, they were apparently supplied by these foodstuffs.

The practical application of any research is, in the final analysis, its test of accomplishment. We may ask, therefore, why we encounter such a widespread prevalence of dental caries, if control is dependent on simple foods, readily obtainable?

We must first regard the problem as one of maintaining normal body function and not one of local mouth health. It is more of a problem with the child than the adult because the child's requirements for growth and development create a greater metabolic strain. Moreover, the child's environment is largely determined by his adult associates. The adult on the other hand, unless undergoing a period of metabolic strain, such as pregnancy, lactation or debilitating disease, may be better able to withstand the inadequacies of diet.

We believe that dental caries is primarily dependent on the ingestion of inadequate diet and recommend the following procedure as an aid in its control:

A complete history of the case is taken, including not only an examination of the mouth and teeth, but also a briefly recorded tabulation of the child's general physical condition. If abnormality other than dental is suspected, the patient should be referred to a competent physician with whom the dentist can cooperate in the treatment.

The parent is then given a diet check-up sheet and asked to keep an accurate record of the child's food intake for a period of three days.

This record is then checked against the diet sheet according to the age group into which the child falls; 3 to 5; 5 to 7, or 7 to 16 years, and corrections are pointed out to both the parents and the child. The mother is given a sheet to follow. It is essential that the patient

be seen at frequent intervals until the new régime has been established, and thereafter regularly about every four months.

You may question the necessity for a diet check-up when the presence of dental caries already establishes the fact that the diet is inadequate. In answer to this, it is well to remember that many parents are attempting to feed their children in the right way, and gross criticism of their method will bring no good result. Again, parents many times think that their family is eating an adequate diet because the food is prepared and placed on the table. However, the majority of children's diets are not so adequate as they would first appear. This was forcibly emphasized by an experience with three children of the same family in one of our controlled groups. The mother, after reading the diet instruction sheet, remarked that her children were receiving essentially that same diet. After keeping an accurate check on the actual intake of food for a time, and finding that the children gained weight consistently on the new régime, she volunteered that the children obviously were not eating the whole menu, although it was offered.

The most frequent inadequacies found in diets checked were: irregularity with which essentials are included; the overingestion of carbohydrate foods, with the resulting omission of some of the more important foods; the absence of cod-liver oil from the diet, and intake of too little milk, and of inadequate amounts of fruits and vegetables.

The diet recommended is liberal, and one of inclusion rather than exclusion. Our present concept is that tooth integrity may depend on the adequacy of the diet in all essential factors. Nothing has been noted to indicate that the arrest of caries was primarily dependent on the limitation of the amount of any of the foods commonly used. However, the use of any one in excessive amounts may lead to the omission from the diet of other essential foods, and such omission, if continued, may lead to susceptibility to dental caries.

Published observations of others would indicate that it is possible to control and arrest caries in some cases by the addition to the diet of certain specific factors. This is indicated by the work of Mellanby,[2] who reports that "in a batch of twenty-one children whose average age was about 5½ years, the addition of vitamin D in the form of irradiated ergosterol checked the initiation of new carious points, diminished the spread of old carious points and arrested the infective process in many teeth."

Howe[3] reports that "a deficiency of the antiscorbutic factor has played a part in the production of caries." These observations do not demonstrate that any one specific factor is adequate for prevention and arrest of caries. In the light of present knowledge, and our observations, it is reasonable to believe that a diet adequate in all essential factors is the best to follow.

The degree of improvement in the dental as well as the general physical condition will depend on the regularity with which the essentials of the recommended diet are eaten.

2. Mellanby, May, and Pattison, C. L.: Vitamin D in Preventing Spread and Arresting Caries in Children, Brit. M. J., 2:1079 (Dec. 15) 1928.

3. Howe, P. R.: Investigations of Dental Caries, J.A.D.A., 14:1864 (Oct.) 1927.

DENTAL HEALTH WEEK

By C. J. HOLLISTER, D.D.S., Harrisburg, Pa.

THE public is becoming more and more tooth-conscious. In a large measure, this is due to commercial advertising, via newspapers, magazines and the radio, simply as a means to the stimulation of sales of toothbrushes and dentifrices. Some of these campaigns have been promoted in a manner above criticism; some have been very questionable in character. Regardless of the motive, there is no question that people are today very much tooth-minded.

The observance of a set dental health week is a means by which the dental profession can and should, in a dignified way, carry proper information to the public concerning the care of the mouth and teeth and its importance as regards the general health. From past experience in Pennsylvania and from observations elsewhere, we know that a properly conducted dental health week is of very great value and is enthusiastically received. The attitude of the medical profession toward this idea is expressed in an editorial appearing in the *Blair County Medical Society Bulletin:*

> We thought that every week in the year's calendar had been set aside for some drive or other, but it appears we were mistaken. One week at least was not snapped up and so the State Health Department of Pennsylvania was enabled to use it for dental health. Here was a really worthwhile use of the whole page of the calendar. Of late, there have been so many drives for this and that, with a raisin week and an orange week and a whatnot week. The public is almost leery of drives and "weeks," but dental health strikes so close to the root of our health and happiness that the recent drive merited the approval of everybody.
>
> America is far ahead of other countries in the matter of teeth, but as yet only a beginning has been made. The statement has been made that, in the U. S. A., only about 2 per cent of the people visit a dentist regularly. One-half hour spent with a medical inspector in our public schools will convince the most skeptical that the condition of the average school child's teeth is little less than terrible. True, in Altoona the missionary work has been started and is making good progress, but the work in the schools will have to be multiplied tenfold before the situation can be said to be in control. The public conscience must be awakened so that our school authorities will feel warranted in spending enough money to do more school hygiene.
>
> Dental health week and kindred propaganda aim to show the public how important good teeth are and how to get and keep them.

We base our statements regarding the popularity of this movement to a degree on the amount of newspaper publicity, voluntarily given, year after year. Since 1925, practically every paper in the State has carried news items on this subject, preliminary to and during the entire dental health week.

It is time the dental profession recognize the fact that they must constructively take their place in the program of health education, which is growing so rapidly at the present time. They should be practicing and preaching health dentistry. Dental health week activities give local dentists an opportunity, without criticism, to convey preventive educational material to the general public.

HOW TO CONDUCT A DENTAL HEALTH WEEK

The following suggestions have been used for the past number of years in Pennsylvania in making plans for the observance of dental health week:

Arrange (where possible) with ministers of all faiths to preach a sermon on dental and general health or, at least, to announce the activities of dental health week.

Enlist the cooperation of local school authorities (public, parochial and private).

School Program.—1. Arrange talks about care of teeth to all school children, by dentists, nurses or dental hygienists.

2. Conduct essay contest on "Care of the Teeth" among school children, prizes to be given by parent-teacher associations, Rotary, Kiwanis, Lions, Quota and civic clubs or any other local organizations; the judges to be the superintendent or principal of schools, a dentist and a member of club or organization awarding prize. An essay contest can be conducted in rural schools.

3. Care of teeth and general health posters are made as part of drawing lesson in all schools.

Community Program.—1. Arrange for dental program for all community organizations, such as Rotary, Kiwanis, Lions, Quota and civic clubs.

2. Where possible, have a community mass meeting, having dental hygienist, nurse or teachers, train children in health playlets, toothbrush drills, etc.

3. Have a dentist give a talk on the care of baby teeth, with a description of the first permanent molar and statement as to its value to mothers at all baby clinics.

4. Where it is possible to finance it locally, have stickers made to be placed on automobile windshields carrying the following slogan (size 5 by 8):

DENTAL HEALTH WEEK
WATCH YOUR TEETH
APRIL 28 TO MAY 3, 1930

Larger cards with the same slogan should be placed in show windows of local stores. Where there are trolleys, have this slogan at the front and rear of and inside cars, if possible.

5. Have drug stores and all other places selling toilet articles make a window display of toothbrushes and dentifrices.

6. Have motion picture houses and theaters make and show five slides. Suggested thoughts for slides are:

1. Dental Health Week
Watch Your Teeth
April 28 to May 3rd, 1930.
2. Good Teeth
for
Good Health.
3. False Teeth Are Like Crutches
to Help a Lame Man Walk.
Keep Your Own.
4. "A Stitch in Time Saves Nine"
Applies to Teeth as Well as
to Torn Garments.
5. Visit Your Dentist Twice a
Year and Your Dental Troubles
Will Be Little Ones.

7. Where a dental hygienist is available, arrange to have her demonstrate in the window of a local department store, using portable equipment and working on school children. Put on two demonstrations a day, 11:30 a. m. to 1:30 p. m., and 2:30 p. m. to 4:30 p. m. The foregoing has proved very effective.

8. Obtain all newspaper publicity possible, carrying notices of events of the week and prepared articles on "Teeth and Health."

9. Where there are local radio stations, experience has proved that these stations will give time for radio talks on dental health.

In following out any of the foregoing suggestions, the cooperation of local civic organizations should be enlisted.

The suggestions given above are to be used in part or as a whole, added to or improved on according to personal opinion and local conditions. The object of this campaign is to give the public proper information on the importance of care of the mouth. The application of any plan or activity that will accomplish the foregoing should be used whether mentioned in these suggestions or not.

Do not fail to report any activities in your community during this week to Dr. C. J. Hollister, Department of Health, Harrisburg, Pa., so that the Mouth Hygiene Committee may have a complete report to make at the State Meeting.

WHEN TO CONDUCT DENTAL HEALTH WEEK

In Pennsylvania, observation of dental health week has been statewide for the past five years. For the last three years, we have had a definite cooperative tie-up with the Pennsylvania Division of the American Child Health Association, and dental health week activities are definitely a part of the nationally observed child health day programs. This has proved to be a very beneficial connection, in that it eliminates a great deal of duplication of effort, for child health and preventive dental health are very closely associated, and we are able to make all activities far more effective owing to the national popularity of child health day.

The stimulating reaction to the promoters of these dental health weeks is the whole-hearted response by the dental profession to the call for community service, showing that our profession is awakening to the fact that it has an obligation beyond the restricted number of people making up the individual practice, and that the true service the dentist owes to humanity is prevention by education. A leading railroad official stated in a railroad magazine not long ago that the frightful toll of human lives lost in crossing casualties could only be eliminated by educating the public. This is a truism that applies to matters of health as well.

It is our hope that this idea will grow until we will have a national dental health week sponsored by the American Dental Association; for our experience in this work prompts us to say that, by this method, the dental profession can reach the greatest number in the shortest time. The press and people of the country seem to be eager for information on preventive dentistry. The interest shown by school authorities indicates that, through this medium, we will eventually have fifty-two dental health weeks annually instead of one.

MAY FIRST—NATIONAL CHILD HEALTH DAY, 1930

THE first day of May has been designated as National Child Health Day, at which time an effort will be made to focus the thought of the nation on constructive measures to improve and protect the health and well-being of its young citizens. Many states and communities have organized "child health councils" which are now busily completing plans for proper observance of this day.

The future of every nation depends on the welfare of its children. These precious units which will make up the citizenship of tomorrow must receive the best care that intelligence and concerted effort can provide. The physically and mentally fit must be kept fit, and those less fortunate must be brought as near to the standard of health as is possible. Neglect of child health must be stopped, and intelligent care must take its place. This may largely be accomplished through the education and enlightenment of parents and children alike, by those who have been trained to care for the various health needs of the population. Physicians, dentists, nurses, hygienists, social service workers, teachers, and public spirited citizens will all contribute their share.

Is the dental profession going to be represented as it should be in this laudable effort? Are our state and local mouth hygiene committees and societies alert to this opportunity for service? Are the individual dentists throughout the United States, in rural as well as in urban localities, aware of the fact that May 1 is National Child Health Day; that their communities should fittingly observe that day; that the dental phase of health for the child should receive definite consideration along with all other phases; that they, as dentists, should closely identify themselves with their state and local programs for child health?

It is not enough to await an invitation to assist—that invitation may never be received. It is advisable that an offer of assistance be made and the offer followed by action. May Day is near at hand and the time is short. If dental societies, mouth hygiene committees and individual dentists have not yet acted to assist in this worthy effort, they should make haste to offer their support to their state and local child health councils. If such a council or committee does not exist and no May Day program has been developed, a determined effort should be made to correct these conditions. At least, if a May Day-National Child Health Day program is observed anywhere in the United States and the health lesson which dentistry has to offer is not properly presented, only the dental profession can be held to blame.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Focal Septic Lesion and Eye Diseases: To controvert the statement of a well-known ophthalmologist that he had never seen ocular disease dependent on dental sepsis, A. F. MacCallan (*Brit. M. J.*, Nov. 23, 1929; abstr. *Dent. Surgeon,* Dec. 14, 1929) reports his experience in cases of pyorrhea, apical abscess, presence of septic stumps of teeth or impacted teeth, residual sepsis or bone infection and even a moderate amount of tartar. In the last mentioned case, thorough scaling was followed by subsidence of an iritis. The author believes that many ophthalmologists have too little knowledge of the groundwork of dental science. Oral conditions are as likely to produce ocular changes as are such conditions as inflammation of the appendix, gallbladder or intestinal tract, gonoccoccal infection or tonsillar conditions, or pelvic conditions in woman.

Vincent's Angina and Fusospirochetal Disease of the Lungs: Three cases of fusospirochetal disease of the lungs which followed contact with cases of Vincent's infection are reported by David T. Smith (*J. A. M. A.*, Jan. 4, 1930). Two cases were primary infections of the pharynx with subsequent extension into the lungs. The third case was primary in the lungs and began four days after contact with a case of Vincent's infection.

Comparative Value of Irradiated Ergosterol and Cod Liver Oil: Barnes, Brady and James (*Am. J. Dis. Child.*, January, 1930) reach the following conclusions as to the comparative value of irradiated ergosterol and cod liver oil as a prophylactic antirachitic agent when given in equivalent dosage according to rat units of vitamin D., the material being obtained from a child clinic with no attempt to select cases: 1. Cod liver oil prevented or cured rickets in 95 per cent of the cases studied when given in a dosage of 3 teaspoonfuls daily (1,400 rat units of vitamin D). Considering the subjects who were normal or improved at the end of the experiment, 98 per cent were either well or benefited. 2. A mixture of cod liver oil plus irradiated ergosterol in a dosage of 3 teaspoonfuls (3,750 rat units of vitamin D daily) prevented or cured rickets in 98 per cent of the cases. There was no evidence of superiority among this group as compared with the group given cod liver

oil. 3. Irradiated ergosterol in a daily dosage of 1,250 rat units of vitamin D prevented or cured rickets in only 44 per cent of the cases studied. The results in this group were not significantly better than those for the control group of untreated subjects. 4. Cod liver oil in a dosage of 1,400 rat units of vitamin D per day was a much more satisfactory antirachitic agent than was the irradiated ergosterol in the approximately equivalent rat unit dosage. It would seem that we are not justified in considering rat units of vitamin D in irradiated ergosterol as being the equivalent of the same number of rat units of vitamin D in cod liver oil as a curative or prophylactic remedy for rickets. 5. There is no definite evidence of a greater incidence of rickets among formula-fed than among breast-fed infants. 6. There is evidence of a greater need for protection against rickets among colored infants, as is shown by the greater final incidence of rickets among these infants in the control series and in the group given irradiated ergosterol. It is also clear that these infants are protected successfully by a daily dose of 3 teaspoonfuls of cod liver oil (1,400 rat units).

Celiac Disease: Martha Van Kirk Nelson (*Am. J. Dis. Child.,* January, 1930) reports metabolic observation in four cases of celiac disease. The children were fed successfully, adequate utilization of food being demonstrated by normal growth, arrest of dental caries and improved metabolism. Protein milk was found to be inadequate owing to increased fat and calcium output as shown by fecal analysis. Proteins such as boiled skimmed milk, cottage cheese, egg white and sieved liver were well tolerated. The enzyme theory concerning the efficacy of the banana was not substantiated. Whatever value the banana has in the treatment for celiac disease apparently is dependent on the availability of the sugar. This is probably due, in part at least, to the softness of the cellulose. When given between meals, dextrose was tolerated in relatively large amounts and permitted an adequate energy intake.

Antirachitic Activation of Cereals: Harry Steenbock and associates have demonstrated that various cereal products, viz., whole wheat meal, patent white flour, shredded wheat biscuits, cream of wheat, whole corn meal, corn flakes, hominy and rolled oats were made antirachitically active by irradiation with ultraviolet rays. This activity was found stable to autoclaving for thirty minutes at 15 pounds pressure followed by drying at 60 C. for a few days. Storage for sixteen months at 60 C. or at lower temperatures did not cause destruction, but after from twenty-three to twenty-eight months, there was a decrease in potency. However, long before this time, even untreated cereals kept at 60 C. were rendered too unpalatable for human use. Household cooking does not have any effect on the activity. Vitamin A and the vitamin B complex are labile to ultraviolet radiations, but evidence of their destruction in cereals can probably not be obtained with such an exposure as is necessary to secure maximum antirachitic activation. The commercial irradiation of cereals was standardized so that the activity induced did not exceed by a multiple of 3 that necessary to form bone of maximum ash content, thus preventing change in palatability, destruction of vitamins and all possibility of hypervitaminosis. By the feeding of commercially irradiated rolled oats, rickets was prevented in dogs and rats and no interference in growth or in reproduction was shown in the latter over a period of fifteen months in four generations.

Cancer of Breast and Abscessed Teeth: One sees a tumor often in the breasts of young and middle-aged women who may or may not have borne children. Many of these cases have been associated with a cervicitis, abscessed teeth, and secondary anemias. The breasts of these patients which showed no definite signs of malignancy have not been touched. The associated lesions, on the other hand, have been treated at once. The abscessed teeth have been removed, the cervicitis has been treated, and an attempt has been made to clear the anemia. It is surprising how many breast lesions have disappeared under this treatment. Our method is to institute the treatment of these associated lesions at once. If the breast lesion does not recede or disappear within two to four weeks, operation is then advised. Of the twenty-one cases of this type seen during the last one and a half years, seven have been operated on and six found malignant.—M. T. Burrows, in *California and West. Med.,* February, 1930.

Cancer Supervention in Skin Diseases: Eller and Anderson (J. A. M. A., Feb. 8, 1930) list twenty-two skin conditions which may be forerunners of cancer. Leukoplakia of the

mucous membranes of the tongue and buccal mucosae, they state, has always been regarded as potentially dangerous because it has frequently been followed by cancer, especially in advanced cases. While the greater number of cases, especially those in which all irritation is removed, do not eventuate in cancer, when the white patches begin to fissure or to show signs of inflammation, they are approaching malignancy, if they are not already malignant. Bloodgood considers leukoplakia second in importance to bad teeth in the etiology of cancer of the mouth. In a series of 160 cases, he found leukoplakia in 25 per cent. Mantilla, in studying 566 cases, found a percentage of 32. Most observers agree that leukoplakia of the tongue and lips is far more prone to become cancerous than leukoplakia of the buccal mucosae and gums. Leukoplakia shows a striking predilection for the male sex, and occurs most frequently between the ages of 40 and 60. Syphilis, the use of tobacco, irritation from rough and jagged teeth and gastro-intestinal disturbances are important etiologic factors in the disease. Treatment consists in prophylaxis and removal of all irritants. When the patches show a tendency to proliferate, recur or fissure, they should be promptly destroyed by electrocoagulation. When there is less infiltration but removal is desired, electrodesiccation is the treatment of choice. The following therapeutic agents are condemned: radium, roentgen rays, carbon dioxid show, chemical caustics of all kinds and electrolysis. The other mouth condition specifically referred to is papilloma of the tongue, which is also frequently the result of use of tobacco and the presence of bad teeth. The authors quote the statement of Ewing that, while some papillomas long remain benign and enjoy a limited growth, there is a strong tendency toward malignant change, which is indicated by increasing growth, induration and fixation of the base and ulceration. When cancer occurs, it is of the squamous variety.

Abnormal Dentition: A patient, aged 6 years, showed on examination two canine teeth occupying the position of upper central incisors, four temporary first molars and four permanent first molars posterior to the deciduous ones. The hair of the patient was fine, fair and sparse. The intelligence was normal. Dental films showed no unerupted teeth. Roentgenograms of the epiphyses and of the sella turcica showed a normal condition. No teeth were cut until the eighteenth month; these were the canines in the position of the central incisors. The four temporary first molars were cut between the second and third years, and the four permanent molars at about 5½ years.—Jean Smith, in *Proc. Roy. Soc. Med.,* March, 1929; abstr. *Am. J. Dis. Child.,* December, 1929.

Dental Malformations and Caries: From his studies, the author (H. H. Reese) concludes that the problem of dental abnormalities and caries is a problem in nutrition and metabolism and not of oral hygiene. The paper emphasizes the following points: 1. The nutrition of the mother influences the structure of the teeth of her offspring and determines the incidence and extent of subsequent caries. Prevention of caries begins, therefore, with the prenatal hygiene of the mother. 2. The term delayed or difficult dentition is questioned, the author believing that all such cases can be classified as due to exudative or spasmophilic diathesis, infectious diseases, endocrine disorders, rickets, syphilis and feeblemindedness. 3. The various discolorations of teeth are not to be regarded as the result of poor oral hygiene entirely. Greenish discoloration about the neck of the upper incisors is seen in children suffering from nutritional disturbances, to be followed later by caries; brown spots on the surfaces of incisors and cuspids are not iron deposits from drinking water but are the residuals of damage to the structural anlage. 4. The teeth seen in rickets are delayed, irregular and asymmetrical. Upper incisors are dwarfed, and horizontal grooves or pits are frequent. Caries appears at the margins early. These teeth are usually yellowish. The alveolar processes also show the lack of calcium and vitamin D, and malocclusion results from the muscle pull on the soft bony structures. 5. The author calls the attention to the predominance of dental disorders in the young and especially the occurrence in the periods of puberty and pregnancy, thus indicating a relation of the thymus and parathyroids, and the debilitating influences of syphilis on the endocrine system are stressed.—*Am. J. Dis. Child.,* December, 1929.

Contractures of the Hand: All injuries of the hand should be given the benefit of physical therapeutic measures. This consists of the selection of the proper electrical stimulation, massage, passive, and active motion,

as well as home exercises. With these measures the convalescent period is shortened, the patient suffers far less pain, contractures are reduced to a minimum, and maximum function is restored.—Louis Gries, in *Arch. Phys. Ther.*, January, 1930.

Foreign Literature

Local Anesthesia (Guido Fischer, Fortschr. d. Zahnheilk. [Leipsic: Georg Thieme] No. 1, 1930, p. 64): In local anesthesia we are still dealing with very many factors not fully understood. These pertain to solutions, instrumentarium and technic, on the one hand, and tissue reaction, on the other. Concerning tissue reaction, it has recently been shown that the alkaline reserve is lowered during the first six hours following anesthesia. It has also been demonstrated that the fatal dose with the use of cocain and tutocain is reduced in liver diseases. Consequently, extensive local anesthesia is contraindicated in those cases. Since we use only small quantities of anesthetics in dentistry, and, in addition, find little use for cocain and tutocain, those observations interest us only in a small degree. The use of cocain is indicated only in pressure and superficial application anesthesia. Psicain is suggested as a substitute for cocain as an anesthetic to be applied to the mucous membrane, because serious after-effects have been recorded from the use of a 1 per cent cocain solution superficially applied. The absorption of cocain through the mucous membrane is extraordinarily rapid. Psicain is best used in the form of a paste. Psicain is mixed into a paste with ethyl aminobenzoate, phenol and paraffin oil. Because of the viscosity of the paste, it is slowly resorbed and the anesthetic action is quite rapid and free from irritation and toxic after-effects. A little of the paste on a small pellet of cotton applied to the previously dried mucous membrane at the point of injection one minute before injection will make penetration of the needle painless, at the same time disinfecting the tissues at the point of injection. A similar application is also useful in the opening of abscesses. Its use is also advocated on the soft tissues in the preparation of teeth for crowns, cementation of crowns and the preparation of deep proximal cavities. Psicain is used as a substitute for cocain. It is ten times more effective than cocain, and the anesthetic effect lasts much longer, but is also more toxic than cocain. Since only one-tenth the amount is required, the toxicity is comparatively reduced. This is probably most useful as a superficial anesthetic prepared in the form of a paste with lanolin (anhydrous wool fat). One hears still a great deal of complaint about undesirable after-effects from the use of procain. This suggests to many that the whole procedure is not yet fully understood. While this is in a sense true, by far the great majority of the more common disturbances, such as after-pain, circulatory disturbances, poisoning, vomiting, edema, prolonged anesthesia and hyperesthesia, are the result of our own failure to observe one or more of the following requisites pertaining to the preparation of solutions and methods of injecting these solutions. The chief requisites governing solutions are: 1. Optimum isotonia and isotonia obtained with the use of proper buffer salt solutions. 2. The use of anesthetics freshly prepared a short time before needed. 3. The use of absolutely water clear solutions, injected at body temperature. 4. If prepared according to the first three rules, an anesthetic solution will be obtained which with a given amount of procain and epinephrin will produce a better and more rapid anesthetic with a smaller quantity of the solution than would be required of a solution improperly prepared or prepared hours before used. 5. If the quality of the anesthetic is raised, the quantity or the concentration of the solution needed is reduced. The requisites governing injection technic are: 1. The mucous membrane at the point of injection must be thoroughly cleaned and positively sterilized. 2. The point of the needle must be sharp (it should be inspected before every injection). 3. The syringe and the needles must be sterile. 4. Absolute knowledge of the actual injection technic, which means (*a*) never to inject into the bone but into the soft tissue just overlying the periostium; (*b*) to inject slowly, using at least one to two minutes for every 2 c.c. solution, without pressure; (*c*) in mandibular injections, muscles and ligaments must be punctured but should never be infiltrated.

Emil Mueller, Chicago.

MISCELLANY

BOOK REVIEWS

Diet and the Teeth: An Experimenal Study. By May Mellanby. 307 pages; illustrated; price, 17 shillings and 6 pence. Published by His Majesty's Stationery Office, London, England.

This work, issued under the auspices of the Medical Research Council, is Part I of this study, entitled the "Dental Stucture of Dogs," and is to be followed by Parts II and III, now under preparation. Part II will consist of a study of the dental structure in animals other than the dog, and on the production of dental disease; and Part III will study the human teeth and the part played by diet in their proper development and formation and in the resistance they offer to disease.

The work of Mrs. Mellanby is so well known that all that is necessary to enlist the interest of the profession is to announce the fact that, in this work, she has gathered in presentable form the essence of her knowledge on this important subject. She has painstakingly gone into detail not only on the subject proper but also on her manner of approaching the study. Even a casual perusal must impress the reader with confidence in her investigations, and while he may not feel that the last word has been said, and while there are still certain manifestations of dental decay that are not satisfactorily accounted for on the sole basis of diet, the fact remains that this is a serious attempt to throw light on the subject and as such it is entitled to our respectful consideration.

The plates in the back of the book, of which there are many, are excellently done, adding greatly to the interest of the text.

The present work is really a notable contribution to the literature of the subject and assuredly leads one to anticipate the publication of Parts II and III.

Dentist's Daily Record; Dentist's Yearly Record. A Progressive Record and Accounting System for Dentists. By Arthur D. Black, A.M., M.D., D.D.S., Sc.D., Dean, Northwestern University Dental School. Price, Daily Record Book, $7, Yearly Record Book, $8; sold together, $14. Published by The Physicians' Record Company, 161 W. Harrison St., Chicago, Ill.

These two companion volumes are calculated to facilitate the keeping of records and accounts by the dentist, and this is probably the first attempt to supply a complete accounting system for a professional group, including personal and household expenditures and investments, leading up to a balance sheet at the end of the year. The plan is based on the U. S. Government blank number 1040, on which professional men are required to make their income tax return.

Dr. Black is endeavoring to counteract "some of the pseud-economics with which the profession is being flooded at the present time," as well as to "emphasize the fact that a dentist does not solve his financial problem by just increasing his fees." It is safe to say that if more system and sincerity were put into our economic problems and less camouflage and pretense, the more surely would the profession come into its own in an economic sense, and it is to this end that Dr. Black has prepared these volumes. We commend them to a careful consideration by the profession.

DENTAL TERMINOLOGY BOOKLET

The Committee on Nomenclature of the American Dental Association has in course of preparation for publication a plan which it is believed will facilitate a comprehensive expansion of dental anatomic nomenclature on a scientific basis.

The plan is practically an adaptation to dental anatomy of the Basle Anatomical Nomenclature, which has been adopted by various anatomic societies and by the medical profession generally. It is the hope of the committee that this booklet will furnish a foundation upon which to expand dental nomenclature to meet the needs in this field.

The Basle Anatomical Nomenclature is based upon sound etymologic principles regarding the formation and use of anatomic

terms and applied in a manner which has been of much service in simplifying and standardizing medical terminology. It is the hope of the committee that the same principles can be utilized in standardizing dental terminology.

As a further aid in the formation of new terms, the committee has included in the work paradigms of Latin nouns and adjectives as a guide to the proper and correct form of new words. There is also included in the work an English-Latin vocabulary, which is intended to facilitate the use of the proposed plan and to stimulate the inventive genius of those interested in this phase of dental science.

The booklet is now in course of publication and will be furnished to members of the American Dental Association interested in this subject, but only to those who specifically request copies.

The committee takes this method to ascertain the number of those who desire copies of the booklet and would ask that those interested send their names and addresses to the chairman of the committee, L. Pierce Anthony, 211 South Twelfth St., Philadelphia, Pa.

JULIO ENDELMAN,
MARTIN DEWEY,
L. PIERCE ANTHONY,
Committee.

JUSTICE NOT CHARITY

By Oliver Wilson White, D.D.S.,
Detroit, Mich.

Why Senator James Couzens is interested in the problems of child welfare and the unemployed is explained in his reply to a letter of the chairman of the Dental Advisory Committee of the Children's Fund of Michigan. To quote from the letter, Senator Couzens states: "In the conversation you had with me, I did not recall that I spoke of child welfare and unemployment as charitable undertakings. I do not think either of them is, and particularly unemployment cannot be construed as a charitable interest.

"The question of justice enters into both cases. I am much more interested in securing justice than I am in being charitable. If justice were considered first, there would be less charity necessary. In fact, it is my conviction that when justice is done, there will be little need for charity. Men are entitled to have continuous employment and an adequate annual income. When this is not accomplished, obviously the need of charity results.

"When employers hire and fire men at will, and without any consideration of their economic needs, certainly a great injustice is done; therefore, my desire to solve that problem so that at least one injustice in our civilization will be corrected.

"An interest in child welfare is, of course, fundamental for the preservation and development of our people. In the first instance, the child comes here without any choice of its own and for many years is wholly dependent on grown-ups, not only for their care, but also for their physical and mental development. Why should a child be left wholly dependent on so many 'ifs'—if the parents are competent, if they have the will, if they have the necessary money to bring up the child, if they have regular income or employment—all these 'ifs' should be eliminated. Society, it is acknowledged, has a great interest in the child, and an interest even greater than that of the parents. If this were not so, why compulsory school education? Why public health departments with power to put children and families into quarantine? I could go on at length to indicate the state's interest in children, entirely outside the interest of the parent, or, perhaps it is better to say, outside the interest that some parents take, or perhaps, better still, the interest that some parents have the ability to take, through economic needs.

"In other words, it is my judgment that much of our need now for charity is the result of inadequate attention to the child. I believe much crime, illness, mental deficiency and so on, could be prevented by the state's taking an early active interest in the proper bringing up of the child. I do not mean that we are to be busybodies nosing into every family's private business, or interfering with the rearing of children; I am looking at it in a broader sense, in a sense in which we can do much to aid the family which is willing to be aided.

"Both of these subjects are big ones, but the real thought behind my interest in them is a matter of justice and not a matter of charity."

When Senator Couzens becomes interested in any problem, be it a public or a private enterprise, he employs no half-hearted measures to bring about its solution. Not only has

he contributed financial support to the extent of some $20,000,000, but he has also given freely of his time, energy and knowledge of efficiency to further the problem of administrating justice to the present generation of children and thereby reflecting benefits on future generations.

CORRESPONDENCE

A WARNING

To the Editor:

A young woman called on me, requesting that I try out a certain mouth wash. The formula was to be given me. She then asked for my card so that she could show her employer that she had called on me. This I gave her as I had frequently done in the past with other agents.

A few days later, I was called on the 'phone and was asked whether I had authorized anyone to state that this preparation had my endorsement and that I had recommended its use. This young woman had shown my card as a proof of my endorsement.

This is to give notice that I have not authorized anyone to use my name for the endorsement of any preparation whatsoever. May I suggest to all who read this that they do not give their cards to any salesman as we do not know to what use these cards will be put.

THADDEUS P. HYATT,
Feb. 19, 1930. New York City.

NEWS

DEATHS

Baldwin, Dennison H., Peoria, Ill.; Baltimore College of Dental Surgery, Dental School, University of Maryland, 1891; died, January 14; aged 59.

Chandler, Harry S., San Jose, Calif.; College of Physicians and Surgeons of San Francisco, A School of Dentistry, 1902; died, January 4; aged 55.

Claypool, F. L., Akron, Ohio; Ohio State University, College of Dentistry, 1918; died, December 29; aged 34.

Duncan, S. Finley, Joliet, Ill.; Chicago College of Dental Surgery, 1888; died, January 26; aged 73.

George, Karl L., Cicero, Ill., Chicago College of Dental Surgery, 1901; died, December 19.

Krim, Charles Dixon, Columbus, Ohio; Ohio State University, College of Dentistry, 1900; died, December 20; aged 61.

Matsutani, Masatoshi, Tokyo, Japan; Baltimore College of Dental Surgery, Dental School, University of Maryland, 1919; died, December 17.

McMartin, Thomas G., Shanghai, China; died, January 25.

Smith, G. Hill, Galesburg, Ill.; Northwestern University Dental School, 1902; died, December 3.

Sweet, Homer A., Los Angeles, Calif.; Northwestern University Dental School, 1913; died, January 7, after a short illness.

ANNOUNCEMENTS*

CALENDAR OF MEETINGS

American Dental Association, Denver, Colo., July 21-25.

American Academy of Periodontology, Colorado Springs, Colo., July 17-19.

American Board of Orthodontia, Nashville, Tenn., April 7.

American Dental Assistants Association, Denver, Colo., July 21-25.

American Dental Hygienists Association, Denver, Colo., July 21-25.

American Dental Society of Europe, Nice, France, April 21.

American Full Denture Society, Denver, Colo., July 18-19.

American Society of Oral Surgeons and Exodontists, Evergreen, Colo., July 18-19.

American Society of Orthodontists, Nashville, Tenn., April 12-14.

Australian Dental Association, Brisbane, July 7-12.

International Dental Federation, Paris, France, August, 1931.

International Orthodontic Congress, London, England, July 20-24.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

and fourth Tuesdays in each month from October to June, inclusive.

April

Alabama, at Montgomery (15-17).
Connecticut, at Stamford (22-24).
Kansas, at Topeka (21-23).
Kentucky, at Louisville (7-9).
Louisiana, at Lake Charles (24-26).
Montana, at Great Falls (3-5).
New Jersey, at Asbury Park (April 30-May 2).
North Dakota, at Bismarck (April 29-May 1).
Oklahoma, at Tulsa (21-24).

May

California, at Sacramento (21-24).
Illinois, at Decatur (13-15).
Indiana, at Indianapolis (19-21).
Iowa, at Des Moines (6-8).
Maryland, at Baltimore (5-7).
Massachusetts, at Boston (5-9).
Michigan, at Detroit (5-7).
Missouri, at St. Louis (19-22).
Nebraska, at Lincoln (19-22).
New York, at New York City (12-16).
North Carolina, at Asheville (5-8).
Pennsylvania, at Philadelphia (6-8).
South Carolina, at Columbia (19-21).
South Dakota, at Sioux Falls (12-14).
Tennessee, at Nashville (13-15).
Texas, at Fort Worth (20-23).
Vermont, at Burlington (21-23).
Virginia, at Richmond (12-15).
West Virginia, at Fairmont (19-21).

June

Arkansas, at Little Rock (2-4).
Georgia, at Atlanta (11-13).
Maine, at South Poland (19-21).
New Hampshire, at Laconia (4-6).
Southern California, at Riverside (2-4).

July

Wisconsin, at Milwaukee (9-11).

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

Alabama, at Birmingham, June 23. E. W. Patton, Secretary, 1807 Comer Bldg., Birmingham.

Connecticut, at Hartford, June 25-28. Almond J. Cutting, Recorder, Southington.

Delaware, at Wilmington, June 18-19. W. S. P. Combs, Secretary, Middletown.

Indiana, at Indianapolis, June 12-16. J. M. Hale, Secretary, Mt. Vernon.

Kentucky, at Louisville, June 6-10.

Maine, at Augusta, June 30-July 2. Alton H. Swett, Secretary, 192 State St., Portland.

Minnesota, at Minneapolis, June 12. W. H. Smith, Secretary, 601 Donaldson Bldg., Minneapolis.

Nevada, at Reno, June 2. G. C. Steinmiller, Secretary, P. O. Box 274, Reno.

New Jersey, at Trenton, June 23. John C. Forsyth, Secretary, 148 W. State St., Trenton.

Rhode Island, at Providence, June 24-26. Albert Midgley, Secretary, 1108 Union Trust Bldg., Providence.

Virginia, at Richmond, June 10. John M. Hughes, Secretary, 715 Medical Arts Bldg., Richmond.

EXAMINATION FOR APPOINTMENT TO DENTAL CORPS, U. S. NAVY

A competitive examination for appointment to the Dental Corps of the United States Navy will begin, June 9, at the U. S. Naval Medical School, Washington, D. C. Candidates must be citizens of the United States, between 21 and 32 years of age at the time of appointment, and graduates of recognized dental schools. The examination will be both theoretical and clinical and the usual duration is about seven days. A circular containing full information relative to the Dental Corps and the prescribed form of application can be obtained from the Bureau of Medicine and Surgery, Navy Department, Washington, D. C. No allowance is made for the expense of applicants appearing for examination.

C. E. RIGGS, *Surgeon-General,*
U. S. Navy.

SOUTH CAROLINA STATE DENTAL ASSOCIATION

The sixtieth annual meeting of the South Carolina State Dental Association will be held in Columbia, May 19-21.

N. W. MACAULEY, *Secretary,*
Medical Bldg.,
Columbia.

KENTUCKY STATE BOARD OF DENTAL EXAMINERS

The Kentucky State Board of Dental Examiners will meet in Louisville, June 6-10.

ROBERT L. SPRAU, *Secretary,*
970 Baxter Ave.,
Louisville.

DENTAL HYGIENISTS ASSOCIATION OF THE STATE OF NEW YORK

The New York State Dental Hygienists' Association will hold its tenth annual meeting, May 13-16, at the Hotel Commodore, New York City. Members of the dental profession, dental hygienists, and dental assistants are invited to attend the session. A literary and clinical program will be presented. Members and nonmembers are urged to be present. The program will include the following speakers: Drs. Alfred Walker, Marion Lerrigo and Rose Schwartz.

MARIE COOP, *Chairman of Publicity,*
New York City.

MASSACHUSETTS DENTAL HYGIENISTS ASSOCIATION

The Massachusetts Dental Hygienists Association will hold its annual meeting May 6-9 at the Copley Plaza Hotel, Boston. All members and registered hygienists are invited.

ESTHER B. RUSSELL, *Editor.*

AMERICAN PUBLIC HEALTH ASSOCIATION, WESTERN BRANCH

The Western Branch of the American Public Health Association will hold its initial meeting in Salt Lake City, June 12-14. This branch includes in its geographic area all of the states west of Colorado, and the Province of British Columbia. An extensive program is being formulated, including discussions of spotted fever, tuberculosis control, meningitis, the sanitary aspects of the proposed Boulder Dam, undulant fever and health education, besides the dental and public health nursing program. (Dentistry is beginning to play a very important part in public health activity.) An invitation is extended to all ethical practitioners of dentistry in the western states to attend this meeting.

A TESTIMONIAL TO M. HILLEL FELDMAN

Saturday, May 17, a testimonial dinner and dance will be tendered to M. Hillel Feldman at the Hotel New Yorker, by his friends in the profession in appreciation of his many years of teaching in the field of anesthesia and exodontia.

EDWARD E. LEBWITH, *Secretary.*
760 Mott Avenue,
New York City.

NEW MEXICO STATE DENTAL SOCIETY

Because the Annual Session of the American Dental Association is to be held in the neighboring state of Colorado, the annual June meeting of the New Mexico State Dental Society has been cancelled for the year 1930.

FRED MULLER, *Sec'y-Treas.,*
Taos.

NEVADA STATE BOARD OF DENTAL EXAMINERS SEMI-ANNUAL EXMINATION

The next meeting of the Nevada State Board of Dental Examiners will be held in Room 8, Masonic Temple Building, Reno, beginning promptly at 9 a. m., June 2. All applications, complete credentials and the fee of $25 must be in the hands of the secretary at least twenty days prior to the examination.

G. C. STEINMILLER, *Secretary,*
P. O. Box 274,
Reno.

SOUTHERN CALIFORNIA STATE DENTAL ASSOCIATION

The thirty-third annual meeting of the Southern California State Dental Association will be held in the Memorial Auditorium, Riverside, June 2-4.

CHARLES M. ALDERSON, *Secretary.*

BOARD OF DENTAL EXAMINERS OF ALABAMA

The Board of Dental Examiners of Alabama will hold its annual licensing meeting in Birmingham, commencing Monday, June 23, at 9 a. m. All correspondence pertaining thereto should be addressed to

E. W. PATTON, *Sec'y-Treas.,*
1807 Comer Bldg.,
Birmingham.

CONNECTICUT DENTAL COMMISSION

The Connecticut Dental Commission will meet at Hartford, June 25-28, for the examination of applicants for license to practice dentistry and dental hygiene, and to transact any other business proper to come before it. Applications should be in the hands of the

recorder at least two weeks before the meeting. For application blanks and further information, apply to

ALMOND J. CUTTING, *Recorder,*
Southington.

SECOND INTERNATIONAL ORTHODONTIC CONGRESS

The Second International Orthodontic Congress shall take place in London about the middle of July, 1931. The object of the congress is the advancement of the science of orthodontics and its practical application. It is hoped that orthodontists and dental practitioners from all parts of the world will attend.

Information regarding traveling facilities and hotel accommodation can be obtained from the official agents to the Congress, Messrs. Morgan Pope & Co., of 7, St. James' Street, London; 6, Rue Caumartin, Paris; 71 Vanderbilt Avenue, New York City; Messrs. Noel Vester & Co. (Agents), 44, Unter den Linden, Berlin. Further details will be published later as organization proceeds.

J. H. BADCOCK,
President-General.
A. C. LOCKETT and
B. MAXWELL STEPHENS,
Secretaries-General.

DENTAL INTERN AT THE LENOX HILL HOSPITAL

The position of intern at the Lenox Hill Hospital will be vacant September 1. The term of service is one year, with full maintenance. Apply in writing not later than April 15 to

GEORGE F. SAUER, *Superintendent.*

EXAMINATION FOR APPOINTMENT IN THE ARMY DENTAL CORPS

An examination of applicants for appointment as first lieutenants, Dental Corps, Regular Army, will be held within the continental limits of the United States, May 19-24. Examining boards will be convened at Washington, Denver, San Francisco and San Antonio. A circular of information concerning the Army Dental Corps can be secured by writing to the Adjutant General, United States Army, Washington, D. C. Applications for permission to take the examination should be addressed to The Adjutant General, U. S. Army, Washington, D. C.

In order to be eligible to take this examination the applicant must be a citizen of the United States; a graduate of a recognized dental school; in good standing in his profession; between the ages of 22 years, six months and 31 years, nine months at the time of examination; and must have been engaged in the practice of his profession for one year and eleven months subsequent to graduation.

There is at present one vacancy in prospect in the Army Dental Corps. In addition to this, it is expected that vacancies occurring before June 30, 1931, will be filled from successful candidates in this examination. Six vacancies occurred last year in the Army Dental Corps; the year before, one. The average for the past five years has been three vacancies per year.

For the Surgeon General:
J. R. BERNHEIM, Colonel,
Dental Corps, *Assistant.*

STATE OF RHODE ISLAND BOARD OF REGISTRATION IN DENTISTRY

A meeting of the Rhode Island Board of Registration in Dentistry for the examination of candidates will be held at the State House, Providence, Tuesday-Thursday, June 24-26, beginning each day at 9 a. m. Candidates shall present to the secretary of this board, at least one week before the examination, a written application on a form provided by the board, together with the examination fee of $20.

ALBERT L. MIDGLEY, *Secretary,*
1108 Union Trust Bldg.,
Providence.

TRI-STATE POSTGRADUATE CLINIC

The Tri-State Postgraduate Clinic will meet in Memphis, Tenn., Oct. 27-30, at the Peabody Hotel. The following clinicians will appear on the program: George B. Winter, St. Louis, Mo.; Rupert E. Hall, Chicago, Ill.; Paul A. Edmand, Chicago, Ill.; Clarence O. Simpson, St. Louis, Mo.; Walter T. McFall, Macon, Ga., and James M. Prime, Omaha, Nebr.

JAMES O. HALL, *President,*
Little Rock, Ark.,
Boyle Bldg.
TERRELL R. OGDEN, *Sec'y-Treas.*
Memphis, Tenn.

STATE OF MINNESOTA BOARD OF DENTAL EXAMINERS

The Minnesota State Board of Dental Examiners will hold the next meeting, June 12, at the College of Dentistry, University of Minnesota, Minneapolis. Applications must be in the office of the secretary by June 1.

W. H. SMITH, *Secretary*,
601 Donaldson Bldg.,
Minneapolis.

VIRGINIA STATE BOARD OF DENTAL EXAMINERS

The next regular meeting of the Virginia State Board of Dental Examiners will be held at the Medical College of Virginia, Richmond, beginning promptly at 9 a. m., June 10. Applicants are required to present a certificate from the state board of education showing that they have had one year of academic work equal to one year of college work. Applications, with fee and photograph, must be filed, complete, ten days before the examination. For application blanks and further information, apply to

JOHN M. HUGHES, *Secretary*,
715 Medical Arts Bldg.,
Richmond.

STATE BOARD OF REGISTRATION AND EXAMINATION OF NEW JERSEY

(A Correction)

The State Board of Registration and Examination in Dentistry of New Jersey will hold its regular examination at Trenton, commencing June 23.

JOHN C. FORSYTH, *Secretary*.
148 W. State St.,
Trenton.

DELAWARE STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Delaware Board of Dental Examiners will be held in the Municipal Building, Tenth and King streets, Wilmington, June 18-19, 9 a. m. to 5 p. m. For further information, address

W. S. P. COMBS, *Secretary*,
Middletown.

NEW JERSEY STATE DENTAL SOCIETY

The Sixtieth Annual Meeting of the New Jersey State Dental Society will be held in the Berkeley-Carteret Hotel, Asbury Park, New Jersey, April 30-May 2.

The chairman, K. C. Pruden, announces the following program:

Wednesday, April 30, 8 p. m.

Practical Phases of Children's Dentistry. F. Blaine Rhobotham, Chicago, Ill.

Thursday, May 1, 10 a. m.

Predetermination of Occlusal Balance before Operative Procedure. Edward T. Tinker, Minneapolis, Minn.

Thursday, May 1, 8 p. m.

The Dental Hygienist. Alfred C. Fones, Bridgeport, Conn.

The clinics, arranged by H. Leo Romine, will cover the following subjects: bridgework, Edward T. Tinker, Minneapolis, Minn.; periodontia, Leo A. Walzak, Baltimore, Md.; porcelain jacket crown, Paul Simonsen, Philadelphia, Pa.; radiography, W. T. Ogus, Washington, D. C.; thimble jacket crown, F. G. Neuruhr, New York City.

Edward C. Stillwell, Glen Ridge, is director of exhibits.

EDWARD L. WHARTON, *President*,
F. K. HEAZELTON, *Secretary*,
223 East Hanover St.,
Trenton.

SOCIETY FOR THE ADVANCEMENT OF GENERAL ANESTHESIA IN DENTISTRY

The next meeting of the Society for the Advancement of General Anesthesia in Dentistry will take place, Monday night, April 21, at 7 o'clock, at the Hotel Buckingham, 101 W. 57th St., corner of Sixth Avenue, New York City. The scientific session will be devoted to a discussion on ethyl chlorid, by Joseph Stovin of the otolaryngological service at the Polyclinic Medical School and Hospital and of the Hospital for Joint Diseases.

LEONARD S. MORVAY, *Secretary*,
76 Clinton Ave.,
Newark, N. J.

M. HILLEL FELDMAN, *President*,
730 Fifth Ave.,
New York City.

MATERIAL ON DENTAL ECONOMICS

available from the

LIBRARY BUREAU

of the

AMERICAN DENTAL ASSOCIATION
58 E. WASHINGTON ST., CHICAGO, ILL.

BOOKS*

Bregstein, S. J.	Business conduct of an ethical practice. Brooklyn, Dental Items of Interest Pub. Co., 1929. Brother Bill's letters and business building articles. New York, Press of Dental Digest, 1909.
Brush, F. C.	Business problems of a profession. New York, Press of Dental Digest, 1911.
Clapp, G. W.	Profitable practice. New York, Dentists' Supply Co., 1916.
Hambly, C. R.	Practice builder. Cincinnati, American Dental Pub. Co., 1897.
Johnson, C. N.	Success in dental practice. Philadelphia, Lippincott, 1903.
Kells, C. E.	Dentists' own book, including a complete bookkeeping and recording system. St. Louis, Mosby, 1925.
Kent, E. N.	Business side of dentistry. St. Louis, Mosby, 1929.
Reilly, T. F.	Building a profitable practice: being a text-book on medical economics. Philadelphia, Lippincott, 1912. Ritter practice building suggestions. Rochester, N. Y., Ritter Dental Manufacturing Co., 1926.
White, Frank	Bookkeeping for dentists. London, Baillierre, Tindall & Cox, 1910.

PACKAGE LIBRARIES†

Business side of dentistry.
Dental economics.

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*Books may be borrowed by members of the Association for a period of one week after date of receipts; and if they have not been reserved for someone else, the period will be extended on request. A deposit of $2.00 should accompany all requests for books. This will be refunded on return of books.

†A package library is composed of reprints, magazine clippings, etc., on one subject only. The packages may be borrowed by members of the Association for a period of one week after date of receipt; and if they are not reserved for someone else, the period will be extended on request. The rental fee for borrowing a package library is fifty cents. This should accompany the request for the package. No packages are sold.

AMERICAN DENTAL ASSOCIATION

Denver, Colorado. July 21-25, 1930.

HOTEL RESERVATIONS

In securing hotel reservations for the 1930 Session, consult the hotel rate-sheet and fill out the blank application below. Mail immediately to the hotel you wish to patronize. The hotel will then advise you of the reservation that has been made for you.

Kindly indicate second and third choices.

Please remember that reservation constitutes a contract with the hotel to provide you with the accommodations you desire. If you find it impossible to carry out your part of the contract, please write or wire the hotel, releasing it.

MAIL THIS APPLICATION DIRECT TO THE HOTEL

HOTEL RESERVATION

AMERICAN DENTAL ASSOCIATION, DENVER, COLO., JULY 21-25, 1930.

.....Hotel. 1930

Please reserve sleeping room accommodations noted below:

.....Room(s) with bath for.....people. Rate desired $.....
(per day)

.....Room(s) without bath for.....people. Rate desired $.....
(per day)

Second choice: .....

Third choice: .....

ROOMS TO BE OCCUPIED BY: ADDRESS IN FULL

....

....

....

Please confirm this reservation to applicant. I further agree to notify the hotel at once in the event I am unable to use this reservation.

IMPORTANT TO HOTEL MANAGER: In the event you cannot accept this reservation, please forward this application at once to Dr. I. R. Bertram, Chairman Halls and Hotels, 1222 Republic Bldg., Denver, Colorado, who will attend to its assignment.

HOTEL	Rooms	Single with Bath	Double with Bath	Single without Bath	Double without Bath
ADAMS 18th & Welton	115	$3.00-5.00	$4.00-6.00	$2.00-2.50	$3.00-4.00
AMBASSADOR 1728 California	92	2.00	2.50	1.50	2.00
ALBANY 17th & Stout	300	3.00-6.00	5.00-10	2.00-3.00	4.00-6.00
ARGONAUT 233 E. Colfax	160	4.00	5.50	2.00	3.00
AUDITORIUM 14th & Stout	200	2.00-3.50	3.00-5.00	1.50-2.00	2.50-3.00
AYRES 1441 Logan	75	3.50 up	5.00-6.00	2.50	4.00
BROWN PALACE 17th & Tremont	300	5.00 up	8.00 up		
COLBURN 10th & Grant	100	3.50-5.00	5.00-8.00		
COLORADO 17th & Tremont	100	2.50-3.00	4.00-5.00	1.50-2.00	2.50-3.00
COSMOPOLITAN 18th & Broadway	460	3.00-5.00	5.00-10.00	1.50-2.00	2.50-4.00
CREST 1924 Welton	114	2.00 up	3.00 up	1.50	2.00
EDELWEISS 1651 California	76	3.00	4.00	2.00	3.00
HARVARD 501 E. Colfax	60	2.50	3.50	1.50	2.50
KENMARK 530 17th	120	2.50-3.50	4.00-6.00	1.50-2.50	2.50-4.00
LANCASTER 1765 Sherman	75	2.50	3.00-5.00	2.00	2.50
MARQUETTE 1725 Curtis	62	2.00	4.00	3.00	3.00
MAYFLOWER 1710 Grant	80	2.50-3.50	3.50-5.00	1.50-2.00	3.00-3.50

(Continued on next page)

HOTEL	Rooms	Single with Bath	Double with Bath	Single without Bath	Double without Bath
MIDLAND 1106 17th	70	3.00	4.00	1.50-3.00	2.00-3.00
MILLS 1321 Logan	60	2.50	4.00	1.50	2.00
NEWHOUSE 1470 Grant	77	3.00	5.00	2.00-2.50	3.00-3.50
OLIN 1420 Logan	125	2.50-4.00	6.00		
O'NEILL 1407 Stout	60	2.00	3.50	1.50	2.50
OXFORD 1612 17th	250	3.50	5.00	2.00	3.50
PAGE 1320 Stout	65	2.00-2.50	3.00-3.50	1.50	2.00
PARK LANE 450 S. Marion			10.00		
PLAZA 330 15th	60	2.00-2.50	3.00-3.50	1.50	2.00-2.50
SEARS 1755 California	94	2.50-3.00	3.00-8.00	2.00	2.50-3.00
SHIRLEY-SAVOY 17th & Broadway	400	3.00-5.00	5.00-8.00	2.00-2.50	3.50-4.00
STANDISH 1530 California	125	2.50	3.50	1.50	2.50
WELLINGTON 1450 Grant	75		3.50		
WEST 1337 California	112	2.50	3.50	1.25-1.50	2.00-2.50
WYNNE 1431 California	100	2.00 up	3.00 up	1.50	2.00
WEST COURT 1415 Glenarm Place	129	2.50 up	3.00 up	1.50	2.00

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